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METHOD FOR COMPUTATION OF STRUCTURAL FAILURE
PROBABILITY FOR AN AIRCRAFT.

9 Final rept.

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structural inspections and rework. The listing of the computer routine and a sample problem to illustrate the method is included.

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FORWARD

This report was prepared by John W. Lincoln, Structures Division of the Directorate of Flight Systems Engineering. The work was done as a research and development task to aid in the structural assessment of aircraft.

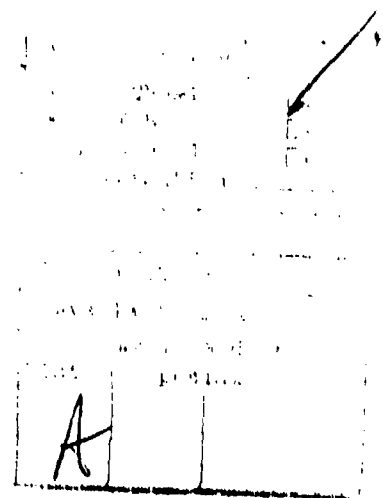


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SECTION 1

INTRODUCTION

In many cases, it is helpful to calculate the failure probability for an aircraft in order to obtain a more quantified indication of the risk involved with a particular course of action. These types of calculations have proven useful in the past for helping managers to select from some difficult options.

The process defined in this report presumes that the analyst has the following:

- (1) The probability density function for crack length for an area(s) of the aircraft that is to be analyzed.
- (2) The probability density function for stress for the area(s) of the aircraft that is to be analyzed.
- (3) The stress in the analysis area(s) at which a given crack size would be critical.
- (4) The inspection reliability for inspections that are to be made.
- (5) The structural rework to be performed (which consists of fastener hole reaming).
- (6) The crack growth in the analysis area(s) as a function of time.
- (7) The mission time for the desired sequence of flights.

This information is input to the computer routine as detailed in Section III. The output of the computation is the single flight probability of failure, the aircraft failure probability, and the expected number of failures in the force. The detailed equations for the computations are given in Section II.

Generally, the single flight probability of failure and the expected number of losses are the more useful outputs of this analysis. For an in-depth discussion of acceptable levels of safety, the reader is referred to Bo Lundberg's Wright Brothers Lecture on "Fatigue Life of Airplane Structures" published in the Journal of the Aeronautical Sciences, June, 1955. Lundberg provides some arguments for safety levels that could be used for commercial aircraft. The maximum allowable single flight probability of failure for a military aircraft is dependent on such factors as the mission of the aircraft, safety of the air crew, and feasibility of modifications and/or inspections to reduce the risk.

SECTION II

DEVELOPMENT OF RISK ANALYSIS METHODOLOGY

1 BASIC FUNCTION DEFINITIONS

Suppose that T is a positive number and that N_p is the number of control points on the airframe, N_M is the number of different missions flown, N_I is the number of inspections in the time interval $[0, T]$, N_R is the number of structural reworks to be performed in the time interval $[0, T]$, and each of b , c , d , and e is a positive integer such that b is in $[1, N_p]$, c is in $[1, N_M]$, d is in $[0, N_I]$, and e is in $[0, N_R]$. Further, suppose that p^{bde} is a simple surface such that the point $(x, t, p^{bde}(x, t))$ is a point of p^{bde} only if x is a positive number, t is a positive number $\leq T$, and $p^{bde}(x, t)$ is the crack length probability density between the d th and $d+1$ inspection and between the e th and $e+1$ rework (note that when $d = 0$, the aircraft has not received an inspection and when $e = 0$ the aircraft has not been reworked) for the crack length x at the b th control point of the aircraft for the flight time t . p^{bde} is called the crack length probability density function corresponding to the b th control point, d th inspection, and e th rework.

Now, suppose that a^{bcde} is a simple graph such that the point $(t, a^{bcde}(t))$ is a point of a^{bcde} only if each of $a^{bcde}(0)$ and t is a positive number and $a^{bcde}(t)$ is the crack length at the time t (based on an initial crack of size $a^{bcde}(0)$) at the b th control point of an aircraft flying the c th mission at the time t after the d th inspection and e th rework. The simple graph a^{bcde} is called the crack growth function for the b th control point and the c th mission and for the d th inspection and e th rework.

Now, suppose that P_I^b is a simple graph such that the point $(x, P_I^b(x))$ belongs to P_I^b only if x is a positive number and $P_I^b(x)$ is the probability that a crack of length x will not be detected during an inspection of the b th control point. The simple graph P_I^b is called the inspection function for the b th control point.

Suppose that $p_{x^{bc}}^{bc}$ is a simple graph such that the point $(x, p_S^{bc}(x))$ belongs to $p_S^{bc}(x)$ only if x is a number and $p_S^{bc}(x)$ is the probability density of the b th control point for the maximum stress x in a single flight of the c th mission. p_S^{bc} is the stress probability density function for the b th control point of an aircraft flying the c th mission.

Next, suppose that S_c^b is a simple graph such that the point $(x, S_c^b(x))$ belongs to S_c^b only if S_c^b is the stress at which a crack of length x at the b th control point becomes critical. S_c^b is the critical crack length function for the b th control point.

Now, suppose that N_F is a simple graph such that the point $(t, N_F(t))$ belongs to N_F only if t is in $[0, T]$ and $N_F(t)$ is the number of flights flown at the time t . N_F is called the flight number function.

Further, suppose that N_{MF} is a simple graph such that the point $(f, N_{MF}(f))$ belongs to N_{MF} only if f is a positive integer in the interval $[1, N_F(T)]$ and $N_{MF}(f)$ is the mission number flown on the flight numbered f . N_{MF} is called the mission number function.

Suppose that t_F is a simple graph such that the point $(f, t_F(f))$ belongs to t_F only if f is an integer in $[1, N_F(T)]$ and $t_F(f)$ is the time just preceding the f th flight. t_F is called the flight time function.

Also, suppose that N_{PW} is a simple graph such that the point $(b, N_{PW}(b))$ belongs to N_{PW} only if b is in $[1, N_P]$ and $N_{PW}(b)$ is the number of points with the same p_C^{bde} , a^{bc} , P_I^b , p_S^{bc} , and S_c^b functions in the computation for the b th control point. N_{PW} is the repeat control point function.

2 INFLUENCE OF INSPECTIONS ON THE CRACK PROBABILITY DENSITY FUNCTION

Suppose that a_I^b is a positive number such that following an inspection at the b th control point, the detected cracks are reworked such that they have crack sizes uniformly distributed in the interval $[0, a_I^b]$.

If the n th inspection at the b th control point is accomplished at the time t after the e th rework then the crack probability function for the crack length x changes from $p_C^{bne}(x, t)$ to $p_C^{bn+1e}(x, t)$.

Based on the definition of P_I^b , if x is in $[a_I^b, \infty]$ then $p_C^{bn+1e}(x, t) = p_C^{bne}(x, t) \cdot P_I^b(x)$ and if x is in $[0, a_I^b]$ then $p_C^{bn+1e}(x, t) = p_C^{bne}(x, t) \cdot P_I^b(x)$

$$+ \frac{1 - \int_0^{a_I^b} p_C^{bne}(Ix, t) P_I^b(Ix) dIx}{a_I^b}$$

where the term

$$\frac{1 - \int_0^{a_I^b} p_C^{bne}(Ix, t) P_I^b(Ix) dIx}{a_I^b}$$

is the uniform probability distribution derived from the population of cracks found and repaired.

3 INFLUENCE OF STRUCTURAL REWORK ON THE CRACK PROBABILITY DENSITY FUNCTION

Suppose that each of a_{RR0}^b and a_{RR}^b is a positive number such that $0 < a_{RR}^b \leq a_{RR0}^b$. The crack length probability density function corresponding to the b th control, d th inspection, and n th structural rework is modified by structural rework as follows: For each point (x, y) in the x - y projection of p_C^{bdn} such that if $x \geq a_{RR0}^b$ then x is replaced by $x - a_{RR}^b$. Therefore, if after this replacement

$$\gamma = \int_0^{a_{RR0}^b} p_C^{bdn}(a_{RR0}^b, t) dx + \int_{a_{RR0}^b}^{\infty} p_C^{bdn}(x, t) dx$$

then,

$$p_C^{bdn+1}(x, t) = \frac{p_C^{bdn}(a_{RR0}^b, t)}{\gamma} \quad \text{for } x < a_{RR0}^b$$

and

$$p_C^{bdn+1}(x, t) = \frac{p_C^{bdn}(x, t)}{\gamma} \quad \text{for } x \geq a_{RR0}^b,$$

It is noted that the new distribution is uniform between 0 and a_{RR0}^b

4 CALCULATION OF THE PROBABILITY OF FAILURE

At a given time the single flight probability of failure can be computed as follows: If it is assumed that at a given time the aircraft crack distribution function is statistically independent of the stress density function for a particular control point then if t is in $[0, T]$, b is in $[1, N_P]$, c is in $[1, N_M]$, d is in $[1, N_I]$, e is in $[1, N_R]$, s is in the x -projection of p_S^{bc} , x is in the x -projection of p_C^{bde} then there is a number

$$p_J^{bdce}(x, s, t) = p_C^{bde}(x, t) \cdot p_S^{bc}(s)$$

which is the joint probability density of crack length and stress for the point (x, s, t) . Since this product exists for each number in $[0, T]$, in the x -projection of p_C^{bde} and in the x -projection of p_S^{bc} then a simple surface p_J^{bdce} called the joint probability density function of crack length and stress is defined.

It follows then that if R^b is a point set such that ordered pair (x, s) is a member of R^b only if the crack length is critical for the stress s (defined by the simple graph S_C^b) then the probability of failure at the b th control point at the time t during one flight of the c th mission is

$$p_F^{bcde}(t) = \int_{R^b} \int p_J^{bdce}[x, s, t] dx ds$$

The probability that there will be no failure at the time t for a single flight of the c th mission is $(1 - p_F^{bcde}(t))$. Therefore, for all control points identical to the b th, the single flight probability of failure is

$$p_{FW}^{bcde}(t) = \prod_{b=1}^{N_{PW}(b)} (1 - p_F^{bcde}(t))$$

and for the aircraft the single flight probability of failure is

$$p_{FWA}^{cde} = \prod_{b=1}^{b=N} p_{FW}^{bcde}(t)$$

From this function, if N_A is the number of aircraft in the population then the expected number of failures in the population at the time t is

$$E_{FWA}^{de}(t) = N_A \left(1 - \prod_{f=1}^{N_F(t)} (1 - p_{FWA}^{MF}(t_F(f))) \right)$$

SECTION III

DESCRIPTION OF COMPUTER PROGRAM

1 NOTATION

The notation for input data to the routine is given later in this section and is not repeated here.

TF Table - a set of numbers used for single linear interpolation to determine the flight time corresponding to the number of missions flown by the aircraft. The maximum number of points allowed in the TF Table is 100.

PCB Table - a set of numbers that contains points of the crack length probability density function for interpolation in the PCBM Table. The maximum number of points allowed in the PCB Table is 51.

PI Table - a set of numbers used for single linear interpolation to determine the probability of not detecting a crack of a given size during an inspection. The maximum number of points allowed in the PI Table is 100.

SCB Table - a set of numbers used for single linear interpolation to determine the stress at which a given crack size will be critical. The maximum number of points allowed in the SCB Table is 100.

PCBM Table - a set of numbers computed from the PCB Table used for single linear interpolation to determine the crack length probability density function for a given crack size. The PCBM Table is modified by the routine to account for crack length change.

PDSBC Table - a set of numbers used for double linear interpolation to determine the stress probability density function for a given stress. Total number of PDSBC Table entries allowed is 1000. Maximum number of stress entries per mission is 50.

AB Table - a set of numbers used for double linear interpolation to determine the crack length for a given mission and time. Used to calculate the incremental crack growth for flight of a given mission(s). Total number of AB Table entries allowed is 1000. Maximum number of crack length entries is 100.

CRACKL(I) - The Ith crack length entry in the PCBM Table.

PCBT(I) - The Ith crack probability density entry in the PCBM Table.

NCRL - The number of crack length entries in the PCBM Table.

DAREAP(I) - Trapezoidal rule approximation to the area

$$\int_{\text{CRACKL}(I)}^{\text{CRACKL}(I+1)} p_{\text{PC}}^{\text{PC}}(Ix,0) dIx$$

PSIL(I) - The Ith stress entry in the PDSBC Table.

PDPSI(I) - The Ith stress probability density function entry in the PDSBC Table.

NPSIL - The number of stress entries in the PDSBC Table.

TIMCLC(I) - The time derived from the TF Table corresponding to the number of flights NFLTS(I).

PFBC(T) - Probability of failure during one flight at the KTth risk calculation (including inspections and reworks) for a single control point.

PFBC = PFBC(T) for a given KT

TIMI(JINSP) - The time derived from the TF Table corresponding to the number of flights NIN(JINSP).

TIMR(JREWK) - The time derived from the TF Table corresponding to the number of flights NRE(JREWK).

TIME(KT) - The time corresponding to the KTth risk calculation (including inspections and reworks).

DELTm - The incremental time between risk calculation points.

TB - The time derived from the AB Table corresponding to a specified crack length and mission. The crack length is an entry in the PCBM Table.

DLAREA - Integration step size for calculation of single flight probability of failure.

PFT(I) - The single flight probability of failure for the aircraft at the Ith risk calculation point.

PF(I) - The probability of failure for the aircraft for the time defined by the Ith risk calculation point.

PFF(I) - The expected number of failures in a force of size NA corresponding to the Ith risk calculation point.

2 COMPUTATION OF AIRCRAFT FAILURE PROBABILITY

The subroutine FINCLC computes the aircraft failure probability as follows: Suppose that

I is an integer

PFT(I) is the single flight probability of failure at the Ith calculation step

PF(I) is the airplane probability of failure at the Ith calculation step

RNF_I is the number of flights between the I-1st and Ith calculation steps

Suppose further that the single flight probability of failure for the RJth flight after the I-1st calculation step can be expressed by

$$PFT_I(J) = PFT(I-1) + \left(\frac{PFT(I) - PFT(I-1)}{RNF_I} \right) RJ$$

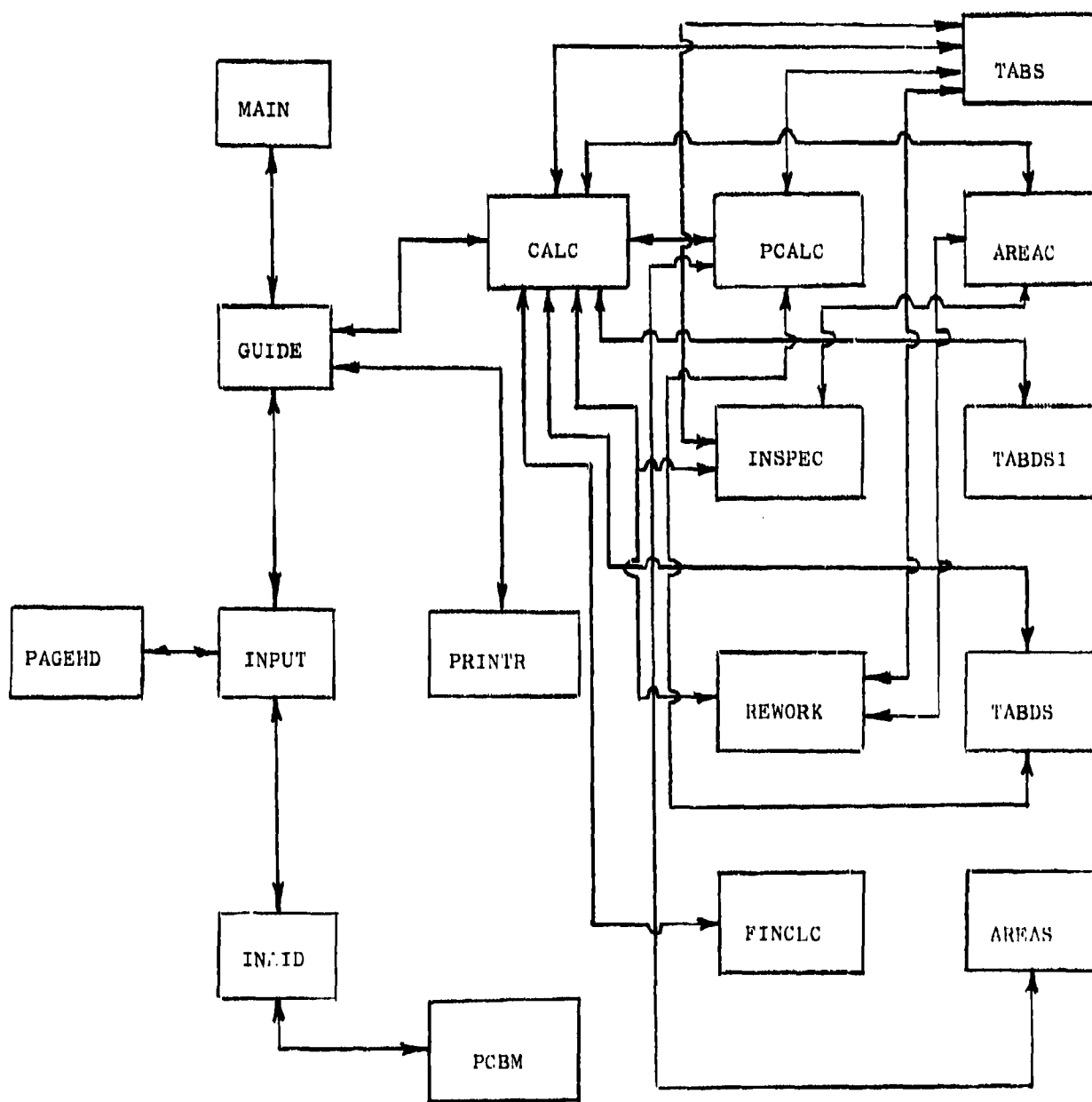
Consequently, the airplane failure probability at the Ith calculation step is

$$PF(I) = 1.0 - \prod_{RJ=1}^{RNF_I} \left(1 - \left(PFT(I-1) + \left(\frac{PFT(I) - PFT(I-1)}{RNF_I} \right) RJ \right) \right)$$

3 COMPUTER FLOW DIAGRAM AND PROGRAM

The computer routine was coded in FORTRAN Extended Language with the main program and subroutines arranged as follows:

RISKY Program (See Appendix A)



MAIN - Main Program - Sets NZERO to zero and transfers program control to GUIDE.

GUIDE - Subroutine - Initially zeros input and output numbers. GUIDE is the primary controlling subroutine that for each of NP control points on the structure transfers control to INPUT, CALC, and PRINTR.

INPUT - Subroutine - Reads in all input data. A procedure for reading in the required input data is given later in the section.

INAID - Subroutine - Called by INPUT and has the purpose of writing out certain input data. INAIID also sets NZERO = 1 for control of data handling in GUIDE.

PCBM - Subroutine - Called by INAIID to modify the PCB table and create the PCBM table. If there are n points in the PCB table and if $x_1, x_2, \dots, x_n$ are the abscissas and $y_1, y_2, \dots, y_n$ are the ordinates of the points of the PCB table then $x_1, x_2, 1.000001x_2, x_3, 1.000001x_3, \dots, 1.000001x_{n-1}, x_n$ are the abscissas and $y_1, y_2, y_2, y_3, y_3, \dots, y_{n-1}, y_n$ are the ordinates of the points of the PCBM table.

PAGEHD - Subroutine - Writes out page heading including run identification, date and page number.

CALC - Subroutine - Performs the following functions:

- (1) Computes flight times for failure probability calculation.
- (2) Corrects the crack length probability density function for error in area.
- (3) Identifies the mission being flown.

- (4) Checks for end of computer run.
- (5) Checks for inspection requirement before next flight.
- (6) Checks for rework requirement before the next flight.
- (7) Establishes new crack probability density function for next failure probability calculation.

PCALC - Subroutine - Integrates the joint probability density function p_J^{bode} to obtain p_F^{bode} .

INSPEC - Subroutine - This subroutine is called when an inspection is to be performed. INSPEC computes the new crack length probability density function after an inspection. Also, it corrects the crack length probability density function for error in area. It is assumed that the cracks found by inspection are repaired.

REWORK - Subroutine - This subroutine is called when a structural rework is to be performed. REWORK computes the new crack length density function after the rework has been performed. Also, it corrects the crack length probability density function for error in area. The rework performed is independent of crack size. The crack population is diminished by the number $a_{RR}^b \leq a_{RR0}^b$.

FINCLC - Subroutine - Called by CALC to perform the following functions:

- (1) Computes the single flight probability of failure for the aircraft.
- (2) Computes the probability of failure for the aircraft.
- (3) Computes the expected number of failures in the population.

TABS - Subroutine - Used for straight line interpolation in a single table look-up.

TABDS - Subroutine - Used for straight line interpolation in a double table look-up. Suppose each of S_x , S_y , and S_z is a number set such that if (x,y,z) is a point of the double table then x belongs to S_x , y belongs to S_y and z belongs to S_z . Further, suppose that S_{xy} is a point set in a plane such that if x belongs to S_x and y belongs to S_y then (x,y) belongs to S_{xy} . The interpolation is on S_z for a point $(\bar{x},\bar{y})$ that is in the plane that contains S_{xy} .

TABDSI - Subroutine - Used for inverse interpolation of in a double table look-up (see TABDS). Suppose that S_{yz} is a point set in a plane such that if y belongs to S_y and z belongs to S_z then (y,z) belongs to S_{yz} . If y is in S_y and z is a number then the interpolation is on S_x for a point $(y,\bar{z})$ that is in the plane that contains S_{yz} .

AREAC - Subroutine - Computes area under a simple graph based on the trapezoidal rule. Maximum number of points from simple graph is 100.

AREAS - Subroutine - Computes area under a simple graph based on the trapezoidal rule. Maximum number of points from simple graph is 50.

PRINTR - Subroutine - Called from GUIDE to print the computed results at the conclusion of the run.

4 INPUT DATA

All of the input data described below is read into the program by means of the subroutine INPUT. This program is a general purpose routine to read the P (parameters), N (integers), and the tables. There are several options by which this may be done by this routine. A suggested arrangement is given as follows:

14I5 Format

IDENT	1	0	NPF3	0	NTI1	NTW1	MONTH	DAY	YEAR	NTI2	NTW2	NA	NCONTP
-------	---	---	------	---	------	------	-------	-----	------	------	------	----	--------

8I5 Format

NP	NTMS	NINSP	NREWK	NMISS	NLEN	NJST	NPRNT
----	------	-------	-------	-------	------	------	-------

72H

Run Description

72H

Run Description

3I5 Format

1	6	1
---	---	---

6E10.3 Format

DELCRK	DELST	TIMAX	AI	ARR	ARRO
--------	-------	-------	----	-----	------

If NTW1 = 0 go to (b); if NTW1 > 0 go to (a)

Integer Set 1

(a)

3I5 Format

51	55	1
----	----	---

5I5 Format

NWT1(1) through NWT1(5)

(b) If NTW2 = 0 go to (d); if NTW2 > 0 go to (c)

Integer Set 2

(c)

3I5 Format

57	58	1
----	----	---

2I5 Format

NWT2(1) through NWT2(2)

(d) If NCONTP < NP go to (f)

If NCONTP = NP go to (e)

(e)

Integer Set 3

3I5 Format

75	74 + NP	1
----	---------	---

NP ≤ 15

12I5 Format

NPW(1) through NPW(NP)

(f)

Integer Set 4

3I5 Format

101	100 + NTMS	1
-----	------------	---

NTMS $\leq$ 400

12I5 Format

NFLTS(1) through NFLTS(NTMS)

Integer Set 5

3I5 Format

501	500 + NTMS	1
-----	------------	---

NTMS $\leq$ 400

12I5 Format

MISS(1) through MISS(NTMS)

If NINSP = 0 go to (h)

If NINSP > 0 go to (g)

(g)

Integer Set 6

3I5 Format

901	900 + NINSP	1
-----	-------------	---

NINSP $\leq$ 20

12I5 Format

NIN(1) through NIN(NINSP)

(h) If NREWK = 0 go to (j)

If NREWK > 0 go to (i)

(i)

Integer Set 7

3I5 Format

921	920 + NREWK	1
-----	-------------	---

NREWK $\leq$ 20

12I5 Format

NRE(1) through NRE(NREWK)

(j) IF NTI1 = 0 go to (l)

IF NTI1 > 0 go to (k)

and read in NTI1 of the following single tables:

(k)

TF Table

I 5, 115 Format

1	NSTAB1
---	--------

NSTAB1 $\leq$ 100

6E10.3 Format

TABLI (1,1) through TABLI(NSTAB1,1) (flight number entries)
--

6E10.3 Format

TABLI(NSTAB1+1,1) through TABLI(2NSTAB1,1) (time entries)
--

PCB Table

I5,I15 Format

2	NSTAB2
---	--------

$NSTAB2 \leq 51 - NINSP$

6E10.3 Format

TABLI (1,2) through TABLI (NSTAB2,2) (crack length entries)
--

6E10.3 Format

TABLI (NSTAB2+1,2) through TABLI (2NSTAB2,2) (crack probability density entries)

PI Table

I5,I15 Format

3	NSTAB3
---	--------

$NSTAB3 \leq 100$

6E10.3 Format

TABLI(1,3) through TABLI (NSTAB3,3) (crack length entries)

6E10.3 Format

TABLI (NSTAB3+1,3) through TABLI (2NSTAB3,3) (inspection probability entries)
--

SCB Table

I5,I15 Format

4	NSTAB4
---	--------

$NSTAB4 \leq 100$

6E10.3 Format

TABLI(1,4) through TABLI (NSTAB4,4) (crack length entries)

6E10.3 Format

TABLI (NSTAB4+1,4) through TABLI (2NSTAB4,4) (critical stress entries)

(1) If NTI2 = 0 go to (n)

IF NTI2 > 0 go to (m) and read in NTI2 of the following double tables:

(m)

PDSBC Table

I5,I15,I10 Format		
1	NDTAB11	NDTAB12
$\begin{aligned} \text{NDTAB11} &\leq 50 \\ \text{NDTAB12} &\leq 400 \\ 2\text{NDTAB11} + \text{NDTAB12} &\leq 1000 \end{aligned}$		
6E10.3 Format		
TABL2(1,1) through TABL2 (NDTAB11,1) (stress entries)		
6E10.3 Format		
TABL2 (NDTAB11+1,1) through TABL2 (NDTAB11 + NDTAB12,1) (mission type entries)		
6E10.3 Format		
TABL2 (NDTAB11 + NDTAB12+1,1) through TABL2 (NDTAB11 + NDTAB12 + NDTAB11 * NDTAB12) (stress probability density entries)		

AB Table

I5,I15,I10 Format		
2	NDTAB21	NDTAB22
$\begin{aligned} \text{NDTAB21} &\leq 100 \\ \text{NDTAB22} &\leq 400 \\ 2\text{NDTAB21} + \text{NDTAB22} &\leq 1000 \end{aligned}$		
6E10.3 Format		
TABL2(1,2) through TABL2 (NDTAB21,1) (time entries)		
6E10.3 Format		
TABL2 (NDTAB21+1,2) through TABL2 (NDTAB21+NDTAB22,2) (mission type entries)		
6E10.3 Format		
TABL2 (NDTAB21+NDTAB22+1,2) through TABL2 (NDTAB21+NDTAB22+NDTAB21 * NDTAB22) (crack size entries)		

(n) End of file.

The first card contains 14 fixed point (integer) numbers arranged in 15 fields. These 14 entries in order on this card are:

- (1) IDENT - Run number
- (2) 1
- (3) 0
- (4) NPF3 - Number of integer sets to be read in - maximum number = 7
- (5) 0
- (6) NTI1 - Number of single tables to be read in - maximum number = 4
- (7) NTW1 = 1 if single tables are to be printed
= 0 otherwise
- (8) Month - Month in date for page heading
- (9) Day - Day in date for page heading
- (10) Year - Year in date for page heading
- (11) NTI2 - Number of double tables to be read in - maximum
number = 2
- (12) NTW2 = 1 if double tables are to be printed
=0 otherwise
- (13) NA - Number of aircraft in the population
- (14) NCONTP - Control point number for this run

The second card contains eight fixed point (integer) numbers arranged in I5 fields. In order these entries are:

(1) NP - Number of control points on aircraft for analysis - maximum number = 15

(2) NTMS - Number of times the risk is calculated in the run excluding the inspection and rework period

(3) NINSP - Number of inspections for this run

(4) NREWK - Number of reworks for this run

(5) NMISS - Number of different missions flown during this run

(6) NLEN - Number of crack lengths used in failure probability calculation

(7) NJST - Number of stresses used in failure probability calculation

(8) NPRNT = 1 if crack length history is to be printed
= 0 otherwise

The third and fourth cards each contain a 72H field for purpose of run descriptions, etc.

The fifth card contains 1, 6, and 1 in I5 fields

The sixth card contains six floating point number arranged in E10.3 fields. These six numbers are placed in the following order:

(1) DELCRK - The crack length interval for integration of the joint probability density function p_j^{bcde}

(2) DELST - The stress interval for integration of the joint probability density function p_J^{bode}

(3) TIMAX - The flight time from zero at the end of the run

(4) AI - a_I^b

(5) ARR - a_{RR}^b

(6) ARRO - a_{RR0}^b

The next cards read in the Integer Sets as required.

Integer Set 1 -

First card contains 51, 55, and 1 in I5 fields

Second card contains NWT1(1) through NWT1(5) in I5 fields

NWT1(i) = 1 if the ith single table is to be printed

NWT1(i) = 0 otherwise

Integer Set 2 -

First card contains 57, 58, and 1 in I5 fields

Second card contains NWT2(1) and NWT2(2) in I5 fields where

NWT2(i) = 1 if the ith double table is to be printed

NWT2(i) = 0 otherwise

Integer Set 3 -

First card contains 75, 74 + NP, and 1 in I5 fields

The next card(s) contain NPW(1) through NPW(NP) in I5 fields

12 entries per card where $NPW(b) = N_{PW}(b)$

Integer Set 4 -

First card contains 101, 100 + NTMS, and 1 in I5 fields

The next card(s) contain NFLTS(1) through NFLTS(NTMS) in I5 fields
12 entries per card where NFLTS(i) is the number of flights at
the ith risk calculation (excluding inspections and reworks) in
the run

Integer Set 5 -

First card contains 501, 500 + NTMS, and 1 in I5 fields

The next card(s) contain MISS(1) through MISS(NTMS) in I5 fields
12 entries per card where MISS(i) is the mission type flown on the
flights $> \text{NFLTS}(i)$ and $\leq \text{NFLTS}(i+1)$

Integer Set 6 -

First card contains 901, 900 + NINSP, and 1 in I5 fields

The next card(s) contain(s) NIN(1) through NIN(NINSP) in I5 fields
12 entries per card where NIN(i) is the number of flights just
preceeding the ith inspection.

Integer Set 7 -

First card contains 921, 920 + NREWK, and 1 in I5 fields

The next card(s) contain(s) NRE(1) through NIN(NREWK) in I5 fields
12 entries per card where NRE(i) is the number of flights just
preceeding the ith rework

The next cards read in the single tables as required.

TF Table -

First card contains 1 and NSTAB1 in an I5 and I15 field respectively
where NSTAB1 is the number of points in the TF table.

The next card(s) contain(s) the flight number entries in E10.3 fields
six to the card

The next card(s) contain(s) the times corresponding to the flight number
entries in E10.3 fields six to the card

PCB Table -

First card contains 2 and NSTAB2 in an I5 and I15 field respectively where NSTAB2 is the number of points in the PCB table. Note that if the PCB table is derived by taking n points from the function p_C^{bde} then the PCB table contains n points

The next card(s) contain(s) the crack length entries in E10.3 fields six entries to the card. If $x_1, x_2, \dots, x_n$ are abscissas of the points taken from p_C^{bde} (arranged such that $x_{i+1} > x_i$) then the crack length entries are $x_1, x_2, \dots, x_n$.

The next cards contain the ordinates from the p_C^{bde} function in E10.3 fields six entries to the card. These entries are ordered as follows: $p_C^{bde}(x_1), p_C^{bde}(x_2), \dots, p_C^{bde}(x_n)$

PI Table -

First card contains 3 and NSTAB3 in an I5 and I15 field respectively where NSTAB3 is the number of points in the PI table and also is the number of points taken from the p_I^b function.

The next card(s) contain the abscissas of the points taken from p_I^b arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the ordinates of the p_I^b points corresponding to the abscissas entries above. The ordinates are entered in E10.3 fields six entries per card.

SCB Table -

First card contains 4 and NSTAB4 in an I5 and I15 field respectively where NSTAB4 is the number of points in the SCB table and also is the number of points taken from the S_C^b function.

The next card(s) contain(s) the abscissas of the points taken from S_C^b arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the ordinates of the S_C^b points corresponding to the abscissa entries above. The ordinates are entered in E10.3 fields six entries to the card.

PCBM Table -

The PCBM table is derived within the Subroutine PCBM from the PCB table. If there are n points in the PCB table, then there are $2n-2$ points in the PCBM table. The first point of PCBM is the same as the first point PCB. If $1 < i < n$ then; the abscissa of the $2i-2$ point of PCBM is the same as the abscissa of i th point of PCB, the abscissa of the $2i-1$ point of PCBM is the abscissa of i th point of PCB $\times 1.000001$, and the ordinate of the $2i-2$ and the $2i-1$ point of PCBM is the ordinate of the i th point of PCB. The last point of PCBM is the same as the last point of PCB.

PDSBC Table -

First card contains 1, NDTAB11, NDTAB12 in an I5, I15, and I10 field respectively where NDTAB11 is the number of stress entries in the table and NDTAB12 is the number of different missions entered in the table which is taken from the p_s^{bc} function.

The next card(s) contain(s) the stress entries $x_1, x_2, \dots, x_{NDTAB11}$ arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the mission number entries $y_1, y_2, \dots, y_{NDTAB12}$ arranged such that $y_{i+1} > y_i$. These numbers are input in E10.3 fields six entries to the card.

The next cards contain the ordinates of the p_s^{bc} function arranged so they correspond to the points $(x_1, y_1), (x_2, y_1), \dots, (x_{NDTAB11}, y_1), (x_1, y_2), \dots, (x_{NDTAB11}, y_{NDTAB12})$ from the entries above. These NDTAB11 $\cdot$ NDTAB12 numbers are input in E10.3 fields six entries to the card.

AB Table -

First card contains 2, NDTAB21, NDTAB22 in an I5, I15 and I10 field respectively where NDTAB21 is the number of time entries in the table and NDTAB22 is the number of different missions entered in the table.

The next card(s) contain the time entries $x_1, x_2, \dots, x_{NDTAB21}$ arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the mission number entries $y_1, y_2, \dots, y_{\text{NDTAB22}}$ arranged such that $y_{i+1} > y_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the crack lengths arranged so that they correspond to the pair $(x_1, y_1), \dots, (x_{\text{NDTAB21}}, y_1), (x_1, y_2), \dots, (x_{\text{NDTAB21}}, y_{\text{NDTAB22}})$. These NDTAB21, NDTAB22 numbers are input in E10.3 fields six entries to the card.

5 EQUIVALENCE TABLES

The technique that has been used in coding this routine is to place all input and output numbers in blank common. All input and output floating point numbers are called parameters and are contained in P (dimensioned 9000). All input and output fixed point numbers are called integers and are contained in N (dimensioned 1500). To make the program more easily read, EQUIVALENCE statements are used to give the P and N number more recognizable names. The RISKY program parameter and integer tables are given below. Also given below is a brief description of the tables used for interpolation.

Integer Equivalence Table

N	Dimension	Term	N	Dimension	Term
1	(1)	IDENT	51	(5)	NWT1(1)
2	(1)	NPF1	55		NWT1(5)
3	(1)	NPF2	57	(2)	NWT2(1)
4	(1)	NPF3	58		NWT2(3)
5	(1)	NPF4			
6	(1)	NTI1	61	(5)	NTB1(1)
7	(1)	NTW1	65		NTB1(5)
8	(1)	MONTH	69	(2)	NTB12(1)
9	(1)	DAY	70		NTB12(3)
10	(1)	YEAR	72	(2)	NTB22(1)
11	(1)	NTI2	73		NTB22(3)
12	(1)	NTW2	75	(15)	NPW(1)
13	(1)	NA	89		NPW(15)
14	(1)	NCONTP			
15	(1)	NP			
16	(1)	NTMS	101	(400)	NFLT(1)
17	(1)	NINSP	500		NFLT(400)
18	(1)	NREWK	501	(400)	MISS(1)
19	(1)	NMISS	900		MISS(400)
20	(1)	NLEN	901	(20)	NIN(1)
21	(1)	NJST	920		NIN(20)
22	(1)	NPRNT	921	(20)	NRE(1)
			940		NRE(20)
			961	(400)	NUMF(1)
			1360		NUMF(400)
43	(1)	JINSP			
44	(1)	JREWK			
45	(1)	KT			
46					
47	(1)	NPSIL			
48	(1)	NZERO			
49	(1)	NPAGE			
50	(1)	NDCLC			

Parameter Equivalence Table

P	Dimension	Term	P	Dimension	Term
1	(1)	DELCRK	101	(50)	PSIL(1)
2	(1)	DELST	150		PSIL(50)
3	(1)	TIMAX	151	(400)	PFBCT(1)
4	(1)	AI	550		PFBCT(400)
5	(1)	ARR	551	(400)	TIMCLC(1)
6	(1)	ARRO	950		TIMCLC(400)
			951	(20)	TIMI(1)
			970		TIMI(20)
			971	(20)	TIMR(1)
			990		TIMR(20)
			991	(100)	PCBT(1)
			1090		PCBT(100)
			1091	(100)	CRACKL(1)
			1190		CRACKL(100)
			1191	(400)	TIME(1)
			1590		TIME(400)
			1591	(400,15)	PFBT(1,1)
			7590		PFBT(400,15)
			7591	(400)	PFT(1)
			7990		PFT(400)
			7991	(400)	PF(1)
			8390		PF(400)
			8391	(400)	PFF(1)
			8790		PFF(400)
			8791	(100)	DAREAP(1)
			8890		DAREAP(100)
50	(1)	RMISS			
51	(1)	PFBC			
52	(1)	DLAREA			

Interpolation Table Listing

Table	Dimension	Name	Description
TABL1(1,1) TABL1(200,1)	(200)	TF	Flight time vs number of flights
TABL1(1,2) TABL1(200,2)	(200)	PCB	Crack length probability density function vs crack length
TABL1(1,3) TABL1(200,3)	(200)	PI	Inspection function vs crack length
TABL1(1,4) TABL1(200,4)	(200)	SCB	Critical crack length function vs crack length
TABL1(1,5) TABL1(200,5)	(200)	PCBM	Modified PCB Table
TABL2(1,1) TABL2(1000,1)	(1000)	PDSBC	Stress probability density function vs stress and mission type
TABL2(1,2) TABL2(1000,2)	(1000)	AB	Crack size vs time and mission type

6 SAMPLE PROBLEM

The following sample problem is presented to acquaint the user with the input data and the output to be expected. The problem has a single inspection at 2200 flights and a structural rework at 2500 flights. The input cards are as follows:

```
207 1 0 7 0 4 1 8 15 1979 2 1 120 1
    1 30 1 1 1 50 65 0
```

RISK ANALYSIS FOR SEVERE TRAINING INCLUDES INSPECT AND REWORK
SINGLE 0.871 HOUR MISSION CRACK SIZE IN INCHES

```
    1 6 1
0.005 500.0 2265.0 0.050 0.030 0.040
    51 55 1
    1 1 1 1 1
    57 58 1
    1 1
    75 75 1
    320
    101 130 1
    0 100 200 300 400 500 600 700 800 900 1000 1100
1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300
2400 2500 2600 2700 2800 2900
    501 530 1
    1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1
    901 902 1
    2200 3000
    921 922 1
    2500 3000
    1 2
    0.0 100.0
    0.0 87.1
    2 35
```

0.0000316	0.0000398	0.0000501	0.0000631	0.0000794	0.0001000
0.0001259	0.0001585	0.0001995	0.0002512	0.0003162	0.0003981
0.0005012	0.0005310	0.0007943	0.001000	0.0012589	0.0015949
0.0019952	0.0025119	0.0031623	0.0039811	0.0050119	0.0063096
0.0079433	0.0100000	0.0125893	0.0158489	0.0199526	0.0251189
0.0316228	0.0398107	0.0501107	0.0630957	0.0794328	
0.010?	0.0649	0.351	1.622	6.385	21.405
61.154	148.888	308.86	546.00	822.51	1055.85
1154.99	1076.62	855.19	578.86	333.89	164.11
68.737	24.533	7.462	1.934	0.4271	0.08037
0.01289	0.001762	0.0002051	0.2035-04	0.1722-05	0.1241-06
0.7618-08	0.3986-09	0.1777-10	0.0	0.0	
3	14				
0.00	0.01	0.02	0.03	0.04	0.05
0.06	0.07	0.08	0.09	0.10	0.11
0.12	0.14				
1.00	0.96	0.86	0.52	0.36	0.25
0.19	0.15	0.11	0.08	0.06	0.05
0.04	0.04				
4	23				
0.001	0.004	0.005	0.010	0.015	0.020
0.030	0.040	0.050	0.080	0.100	0.110
0.120	0.140	0.160	0.180	0.200	0.202
0.204	0.206	0.208	0.210	1.00	
20000.0	103000.0	95000.0	92000.0	75000.0	70000.0
62000.0	57000.0	56000.0	61000.0	63000.0	70000.0
66000.0	53000.0	43000.0	33000.0	25000.0	24000.0
22900.0	21300.0	20000.0	0.0	0.0	

1	28	1			
15000.0	15700.0	20000.0	20500.0	21000.0	21500.0
22000.0	22500.0	23000.0	23500.0	24000.0	24500.0
25000.0	25500.0	26000.0	26500.0	27000.0	27500.0
28000.0	28500.0	29000.0	29500.0	30000.0	30500.0
31000.0	31500.0	32000.0	32500.0		
1.0					
0.0	0.0	807.2-06	487.8-06	365.9-06	243.9-06
130.66-06	95.82-06	34.84-06	40.08-06	33.10-06	13.94-06
12.18-06	8.72-06	15.68-06	11.84-06	8.36-06	6.80-06
2.96-06	2.28-06	1.38-06	0.878-06	0.664-06	0.348-06
0.262-06	0.140-06	0.112-06	0.088-06		
2	16	1			
0.0	10000.0	12000.0	14000.0	14500.0	15000.0
15500.0	16000.0	16500.0	17000.0	17125.0	17250.0
17375.0	17400.0	17450.0	18000.0		
1.0					
0.0001	0.0010	0.0015	0.0025	0.0030	0.0060
0.0140	0.0260	0.0520	0.0860	0.0960	0.1110
0.1280	0.1500	0.200	0.205		

Based on this input the following output data was obtained.

RUN NO 287 DATE 8/15/1979 PAGE NO 1
 RISK ANALYSIS FOR SEVERE TRAINING INCLUDES INSPECT AND REMORK
 SINGLE HOUR MISSION CRACK SIZE IN INCHES

INPUT DATA FOR RISK ANALYSIS

NUMBER OF AIRCRAFT IN FLEET = 120
 CONTROL POINT NUMBER = 1
 TOTAL NUMBER OF CONTROL POINTS = 1
 NUMBER OF FLI INCH IN ANALYSIS = 30
 NUMBER OF INSPEC. IN ANALYSIS = 1
 NUMBER OF REMORKS IN ANALYSIS = 1
 NUMBER OF DIFF. MISSIONS IN ANAL = 1
 NUMBER OF CRACKS IN PROB CALC = 50
 NUMBER OF STRESSES IN PROB CALC = 65

DELTA CRACK LENGTH IN PROB CALC = .0150
 DELTA STRESS IN PROB CALC = 500.0
 ANALYSIS TIME INTERVAL = 2265.0
 MAX CRACK AFTER INSPEC AND FIX (AID) = .0500
 CRACK REDUCTION AFTER REMORK (APR) = .3500
 REFERENCE CRACK AFTER REMORK (ARRO) = .0400

CONTROL POINT WEIGHTING FACTORS

323

NUMBER OF FLIGHTS AT CALCULATION POINTS
 1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190
 200 210 220 230 240 250 260 270 280 290

MISSION NUMBER AT CALCULATION POINTS

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

NUMBER OF FLIGHTS AT INSPECTION POINTS

2200

NUMBER OF FLIGHTS AT REMORK POINTS

2500

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SINGLE TABLE NUMBER 1
TIME VS NUMBER OF FLIGHTS

NUMBER OF FLIGHTS

1.030E+22

TIME

8.710E+01

SINGLE TABLE NUMBER 2
CRACK DENSITY FUNCTION VS CRACK SIZE

CRACK SIZE

3.162E-05	3.981E-05	5.011E-05	6.310E-05	7.943E-05	1.031E-04	1.259E-04	1.585E-04	1.995E-04	2.512E-04
3.162E-04	3.981E-04	5.011E-04	6.310E-04	7.943E-04	1.031E-03	1.259E-03	1.585E-03	1.995E-03	2.512E-03
3.162E-03	3.981E-03	5.011E-03	6.310E-03	7.943E-03	1.031E-02	1.259E-02	1.585E-02	1.995E-02	2.512E-02
3.162E-02	3.981E-02	5.011E-02	6.310E-02	7.943E-02					

CRACK DENSITY FUNCTION

1.024E-02	6.497E-12	3.551E-01	1.022E+00	6.385E+08	2.107E+01	6.115E+01	1.408E+02	3.088E+02	5.468E+02
8.225E+02	1.355E+03	1.155E+03	1.376E+03	8.551E+02	5.708E+02	3.338E+02	2.041E+02	6.873E+01	2.453E+01
7.462E+00	1.934E+00	4.271E-01	8.037E-02	1.209E-02	1.762E-03	2.051E-04	2.035E-05	1.728E-06	1.261E-07
7.610E-09	3.986E-16	1.777E-11	3.	0.					

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DOUBLE TABLE NUMBER 1
STRESS PROBABILITY DENSITY FUNCTION VS
STRESS AND MISSION NUMBER

STRESS	MISSION NUMBER
1.591E+04	1.970E+04
2.431E+04	2.454E+04
2.951E+04	2.951E+04
1.000E+06	

STRESS PROBABILITY DENSITY FUNCTION	MISSION NUMBER
1.591E+04	1.970E+04
2.431E+04	2.454E+04
2.951E+04	2.951E+04
1.000E+06	

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DOUBLE TABLE NUMBER 2
CRACK GROWTH VS
TIME AND MISSION

TIME

1.7125E+24 1.7250E+24 1.7375E+24 1.7500E+24 1.7625E+24 1.7750E+24 1.7875E+24 1.8000E+24
1.8125E+24 1.8250E+24 1.8375E+24 1.8500E+24 1.8625E+24 1.8750E+24 1.8875E+24 1.9000E+24

MISSION NUMBER

1.0000E+02

CRACK GROWTH

1.8800E-04 1.1240E-03 1.5000E-03 2.5000E-03 3.0000E-03 6.0000E-03 1.0000E-02 5.2000E-02 0.6000E-02
9.6000E-02 1.1100E-01 1.2000E-01 1.2000E-01 1.2000E-01 2.0000E-01 2.0000E-01 2.0000E-01

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CRACK DENSITY AREA CALC.	- TIME STEP = 1	AREA = 1.0102			
STRESS DENSITY FUNCTION CALC.	- AREA = 1.0822				
CRACK DENSITY AREA CALC.	- TIME STEP = 2	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 3	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 4	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 5	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 6	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 7	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 8	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 9	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 11	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 12	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 13	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 14	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 15	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 16	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 17	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 18	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 19	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 21	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 22	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 23	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- NO. OF PTS = 71	AREA = .99992	INSPEC		
CRACK DENSITY AREA CALC.	- TIME STEP = 24	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 25	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 26	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- NO. OF PTS = 32	AREA = 1.0102	REMARK		
CRACK DENSITY AREA CALC.	- TIME STEP = 27	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 28	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 29	AREA = 1.0102			
CRACK DENSITY AREA CALC.	- TIME STEP = 30	AREA = 1.0102			

CONTROL POINT SINGLE FLIGHT FAILURE PROB.

NO	TIME	CP 1	CP 2	CP 3	CP 4	CP 5	CP 6	CP 7	CP 8	CP 9	CP 10
1	0.										
2	8.71E+01	6.									
3	1.742E+02	6.									
4	2.513E+02	0.									
5	3.484E+02	0.									
6	4.355E+02	0.									
7	5.226E+02	0.									
8	6.097E+02	0.									
9	6.968E+02	0.									
10	7.839E+02	3.362E-10									
11	8.712E+02	1.93E-17									
12	9.581E+02	1.596E-16									
13	1.045E+03	5.671E-16									
14	1.132E+03	1.559E-14									
15	1.219E+03	4.15E-14									
16	1.307E+03	2.27E-13									
17	1.394E+03	6.415E-13									
18	1.481E+03	8.878E-12									
19	1.568E+03	1.141E-11									
20	1.655E+03	6.477E-11									
21	1.742E+03	1.673E-10									
22	1.829E+03	5.675E-10									
23	1.916E+03	1.223E-09									
24	1.916E+03	4.891E-11									
25	2.003E+03	1.744E-10									
26	2.090E+03	5.709E-10									
27	2.178E+03	1.85E-09									
28	2.265E+03	9.31E-20									
29	2.265E+03	3.258E-18									
30	2.352E+03	3.855E-18									
31	2.439E+03	4.785E-10									
32	2.526E+03	1.528E-09									

SINGLE FLIGHT FAILURE PROBABILITY
AIRCRAFT FAILURE PROBABILITY
EXPECTED FLEET FAILURES

NP	TIME	FLIGHTS	SINGLE	AIRCRAFT	FLEET
1	6.				
2	8.71E+01	424	6.	6.	6.
3	1.74E+02	258	6.	6.	6.
4	2.61E+02	380	6.	6.	6.
5	3.48E+02	443	6.	6.	6.
6	4.35E+02	507	6.	6.	6.
7	5.22E+02	640	6.	6.	6.
8	6.09E+02	700	6.	6.	6.
9	6.96E+02	850	6.	6.	6.
10	7.83E+02	960	2.27E-12	1.15E-10	1.38E-18
11	8.71E+02	1000	2.27E-12	3.42E-10	4.13E-18
12	9.58E+02	1100	2.27E-12	5.69E-10	6.83E-18
13	1.04E+03	1200	2.27E-12	7.97E-10	9.58E-18
14	1.12E+03	1300	6.82E-12	1.25E-09	1.50E-27
15	1.21E+03	1344	1.36E-11	2.28E-09	2.73E-27
16	1.30E+03	1500	7.27E-11	6.83E-09	7.95E-27
17	1.39E+03	1600	2.36E-10	2.46E-08	2.46E-26
18	1.48E+03	1700	2.81E-09	1.73E-07	2.08E-15
19	1.56E+03	1800	3.65E-09	4.97E-07	5.98E-15
20	1.65E+03	1900	2.05E-08	1.71E-06	2.75E-24
21	1.74E+03	2000	5.99E-08	5.75E-06	6.90E-14
22	1.83E+03	2100	1.81E-07	1.78E-05	2.14E-03
23	1.91E+03	2200	3.91E-07	4.66E-05	5.59E-13
24	2.00E+03	2300	5.52E-06	4.66E-05	5.59E-13
25	2.09E+03	2400	5.52E-06	5.73E-05	6.72E-03
26	2.18E+03	2480	1.69E-07	6.15E-05	7.38E-13
27	2.27E+03	2580	5.31E-07	9.97E-05	1.19E-12
28	2.36E+03	2600	2.27E-07	9.97E-05	1.19E-12
29	2.45E+03	2630	1.04E-07	1.05E-04	1.26E-12
30	2.54E+03	2700	1.23E-07	1.16E-04	1.39E-12
31	2.63E+03	2800	1.05E-07	1.30E-04	1.56E-22
32	2.72E+03	2900	4.89E-07	1.62E-04	1.94E-12

BASED ON 120 AIRCRAFT

APPENDIX - RISKY PROGRAM LISTING

The listing given below is a FORTRAN extended language routine.
Section 3.3 gives the flow diagram for the various subroutines.


```

1      C      SUBROUTINE GUIDE
          SUBROUTINE FOR CALLING INPUT DATA AND CALCULATION ROUTINES
          COMMON P(9888), N(1500), TABL1(200,5), TABL2(1000,2)
          EQUIVALENCE (N(48), NZERO)
          EQUIVALENCE (N(15), MP)
          IF (NZERO) 48, 18
          DO 28 I = 1, 9888
          P(I) = 9.8
          DO 38 I = 1, 1500
          N(I) = 8
          DO 58 I = 1, MP
          CALL INPUT
          CALL CALC
          CALL PRINTR
          CONTINUE
          RETURN
          END
18
28
38
48
58

```

GIDE 1
 GIDE 2
 GIDE 3
 GIDE 4
 GIDE 41
 GIDE 5
 GIDE 6
 GIDE 7
 GIDE 8
 GIDE 9
 GIDE 91
 GIDE 18
 GIDE 11
 GIDE 12
 GIDE 121
 GIDE 13
 GIDE 14

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
1 GUIDE

VARIABLES	SN	TYPE	RELOCATION	INTEGER	ARRAY	REAL	REPL
26 I		INTEGER		21458 N			
21456 MP		INTEGER		21527 NZERO			
8 P		REAL		24484 TABL1			
26354 TABL2		REAL					

EXTERNALS	TYPE	ARGS
CALC		0
PRINTR		0
		0

STATEMENT LABELS	INACTIVE	0	28	58
8 18				
17 48				

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
6 28	I	I	7 8	28	INSTACK
14 38	I	I	9 18	28	INSTACK
28 58	* I	I	11 15	68	EXT REFS

COMMON BLOCKS	LENGTH
/ /	13588

STATISTICS	PROGRAM LENGTH	278	23
CH BLANK COMMON LENGTH	322748		13588
5280CB CM USED			

```

1      SUBROUTINE INPUT
2      SUBROUTINE FOR INPUT OF FLOATING AND FIXED POINT NUMBERS
3      COMMON P(9800), N(1500), TABL1(206,5), TABL2(1000,2)
4      INTEGER DAY, YEAR
5      DIMENSION NTB1(6), NTB12(3), NTB22(3)
6      EQUIVALENCE (N(1), IDENT), (N(2), MPF1),
7      (N(3), MPF2), (N(4), MPF3), (N(5), MPF4), (N(6), NTI1),
8      (N(7), NTW1), (N(8), MONTH), (N(9), DAY), (N(10), YEAR),
9      (N(11), NTI2), (N(12), NTW2), (N(13), NI), (N(14), NCOMP),
10     (N(15), NP), (N(16), NTHS), (N(17), NINSP), (N(18), NREHK),
11     (N(19), NTHSS), (N(20), NLEN), (N(21), NJST), (N(22), NPRT),
12     EQUIVALENCE (N(61), NTB1), (N(69), NTB12),
13     (N(72), NTB22)
14     EQUIVALENCE (N(143), NPAGE)
15     INPUT DATA - CONTROL INTEGERS
16     N(1) = IDENT - PROBLEM NUMBER
17     N(2) = MPF1 - NUMBER OF SETS OF PARAMETERS TO BE READ
18     BY FORMAT 1
19     N(3) = MPF2 - NUMBER OF PARAMETERS TO BE READ BY FORMAT 2
20     N(4) = MPF3 - NUMBER OF SETS OF INTEGERS TO BE READ
21     BY FORMAT 3
22     N(5) = MPF4 - NUMBER OF INTEGERS TO BE READ BY FORMAT 4
23     N(6) = NTI1 - NUMBER OF SINGLE TABLES TO BE READ
24     N(7) = NTI2 - 1 IF SINGLE TABLES ARE TO BE PRINTED
25     N(8) = NTW1 - 2 IF NO SINGLE TABLES ARE TO BE PRINTED
26     N(9) = MONTH
27     N(10) = DAY
28     N(11) = YEAR
29     N(12) = NTW2 = 1 IF DOUBLE TABLE IS TO BE PRINTED
30     N(13) = NI - NUMBER OF AIRCRAFT IN THE POPULATION
31     N(14) = NCOMP - CONTROL POINT NUMBER FOR THIS RUN
32     N(15) = NP - TOTAL NUMBER OF CONTROL POINTS
33     N(16) = NTHS - NUMBER OF TIMES RISK CALCULATED EXCLUDING
34     CALCULATION AT INSPECTION AND REWORK PERIOD
35     N(17) = NINSP - NUMBER OF INSPECTIONS IN RISK ANALYSIS PERIOD
36     N(18) = NREHK - NUMBER OF REWORKS IN RISK ANALYSIS PERIOD
37     N(19) = NTHSS - NUMBER OF DIFFERENT MISSIONS FLOWN IN RISK
38     ANALYSIS PERIOD
39     N(20) = NLEN - NUMBER OF CRACK LENGTHS IN PROBABILITY CALC
40     N(21) = NJST - NUMBER OF STRESSES IN PROBABILITY CALC
41     N(22) = NPRT = 1 IF CRACK LENGTH HISTORY IS TO BE PRINTED
42     NPRT = 0 OTHERWISE
43     SET PAGE NUMBER EQUAL TO ONE
44     NPAGE = 1
45     READ CONTROL INTEGERS
46     READ (5,10) (N(I), I = 1, 22)
47     FORMAT (14I5)
48     CALL PAGEHD
49     READ AND WRITE MISCELLANEOUS RUN INFORMATION
50     READ (5,20)
51     FORMAT (36H
52     1 , 36H
53     2 / 35H
54     3 , 36H
55     WRITE (6,20)

```

```

      C
      60      READ IN PARAMETERS BY FORMAT 1
             IF (NPF1) 30, 70
             DO 60 I = 1, NPF1
             READ (5,48) NP11, NP22, NP33
             FORMAT (3I5)
             READ (5,50) (PIJ), J = NP11, NP22, NP33)
             FORMAT (4E10,3)
             CONTINUE
      65      READ IN PARAMETERS BY FORMAT 2
             IF (NPF2) 80, 110
             DO 65 J = 1, NPF2
             READ (5,90) I, P(I)
             FORMAT (I5, E15.7)
             CONTINUE
      70      READ IN INTEGERS BY FORMAT 3
             IF (NPF3) 120, 160
             DO 70 I = 1, NPF3
             READ (5,130) NMG11, NMG22, NMG33
             FORMAT (3I5)
             READ (5,140) (N(J), J = NMG11, NMG22, NMG33)
             FORMAT (4I2I5)
             CONTINUE
      75      READ IN INTEGERS BY FORMAT 4
             IF (NPF4) 170, 200
             DO 75 J = 1, NPF4
             READ (5,180) I, N(I)
             FORMAT (I5, I15)
             CONTINUE
      80      READ IN SINGLE TABLES
             IF (NTI1) 210, 230
             DO 80 J = 1, NTI1
             READ (5,190) I, NTB1(I)
             NTAB = NTB1(I)
             NTABP1 = NTAB + 1
             NTB = NTB1(I) * 2
             READ (5,50) (TAB1(K,I), K = 1, NTAB3)
             READ (5,50) (TAB1(K,I), K = NTABP1, NTB)
             CONTINUE
      85      READ IN DOUBLE TABLES
             IF (NTI2) 240, 260
             DO 85 J = 1, NTI2
             READ (5,250) I, NTB12(I), NTB22(I)
             NTB12I = NTB12(I)
             NTB22I = NTB22(I)
             NTP = NTB12(I) + NTB22(I)
             NTI1P1 = NTB12(I) + 1
             NTI12 = NTB12(I) + NTB22(I)
             NNTI12P1 = NNTI12 + 1
             NF = NNTI12 + NTP
             READ (5,50) (TAB12(K,I), K = 1, NTB12I)
             READ (5,50) (TAB12(K,I), K = NNTI1P1, NNTI12)
             READ (5,50) (TAB12(K,I), K = NNTI12P1, NF)
             CONTINUE
             CALL INAD
             RETURN
             END
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1      SUBROUTINE INAD
2      SUBROUTINE FOR PRINTING OF INPUT DATA
3      COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)
4      DIMENSION MNT1(5), NTB1(5), NTB12(3), NTB22(3),
5      MNT2(3), NPH(15), NFLT(500), NT4(20), NRE(20), NPRE(20),
6      MISS(40)
7
8      EQUIVALENCE (P(1), DELCRK), (P(2), DELST),
9      (P(3), TIMAX), (P(4), AI), (P(5), APR), (P(6), ARRO),
10     EQUIVALENCE (N(7), NTH1), (N(12), NTH2),
11     EQUIVALENCE (N(13), NA), (N(14), NCONTP),
12     (N(15), NP), (N(16), NTHS), (N(17), NINSP), (N(18), NREWK),
13     (N(19), NMIS), (N(20), NLEN), (N(21), NJST)
14     EQUIVALENCE (N(49), NPAGE)
15     EQUIVALENCE (N(61), NTB1), (N(69), NTB12),
16     (N(72), NTB22)
17     EQUIVALENCE (N(51), NMT1), (N(57), NMT2)
18     EQUIVALENCE (N(75), NPH)
19     EQUIVALENCE (N(101), NFLT), (N(501), MISS),
20     (N(901), NIN), (N(921), NRE)
21     CALL PCBH
22     WRITE (6,10)
23     FORMAT (//10X, 20 INPUT DATA FOR RISK ANALYSIS)
24     WRITE (6,20) NA, NCONTP, NP, NTHS, NINSP, NREWK,
25     NMIS, NLEN, NJST
26     FORMAT (//10X, 30 NUMBER OF AIRCRAFT IN FLEET = , I5
27     /10X, 30 CONTROL POINT NUMBER = , I5
28     /10X, 30 TOTAL NUMBER OF CONTROL POINTS = , I5
29     /10X, 30 NUMBER OF FLT INCR IN ANALYSIS = , I5
30     /10X, 30 NUMBER OF INSPECTION IN ANALYSIS = , I5
31     /10X, 30 NUMBER OF REMOVALS IN ANALYSIS = , I5
32     /10X, 30 NUMBER OF DIFF MISSIONS IN ANAL = , I5
33     /10X, 30 NUMBER OF CRACKS IN PROB CALC = , I5
34     /10X, 30 NUMBER OF STRESSES IN PROB CALC = , I5)
35     WRITE (6,30) DELCRK, DELST, TIMAX, AI,
36     ARR, ARRO
37     FORMAT (//10X, 30 DELTA CRACK LENGTH IN PROB CALC = , F8.4
38     /10X, 30 DELTA STRESS IN PROB CALC = , F8.1
39     /10X, 30 ANALYSIS TIME INTERVAL = , F8.1
40     /10X, 30 MAX CRACK AFTER INSPECTION AND FIX (AI) = , F8.4
41     /10X, 30 CRACK REDUCTION AFTER REMOVAL (ARR) = , F8.4,
42     /10X, 30 REFERENCE CRACK AFTER REMOVAL (ARRO) = , F8.4)
43     WRITE (6,32)
44     FORMAT (//10X, 30 CONTROL POINT WEIGHTING FACTORS )
45     WRITE (6,34) (NPH(I), I = 1, NCONTP)
46     FORMAT (//10X, 30)
47     WRITE (6,35)
48     FORMAT (//10X, 30 NUMBER OF FLIGHTS AT CALCULATION POINTS)
49     WRITE (6,36) (NFLT(I), I = 1, NTHS)
50     WRITE (6,37)
51     FORMAT (//10X, 30 MISSION NUMBER AT CALCULATION POINTS)
52     WRITE (6,38) (NMIS(I), I = 1, NTHS)
53     IF (NINSP) 371, 381
54     WRITE (6,39)
55     FORMAT (//10X, 30 NUMBER OF FLIGHTS AT INSPECTION POINTS)
56     WRITE (6,40) (NIN(I), I = 1, NINSP)
57     IF (NREWK) 382, 393

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09/17/79 10.34.24

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74/74 CPT=1

SUBROUTINE IDAD

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382      WRITE (6,39)
39      FORMAT (/10X, 34NUMBER OF FLIGHTS AT REWORK >DINTS)
      WRITE (6,36) (NREID, I = 1, NREMK)
      NPAGE = NPAGE + 1
      CALL PAGENO
      K = 1
      IF (NMT1) 40, 300
      IF (NMT1(1)) 50, 80
      WRITE (6,60)
      FORMAT (/10X, 21HSINGLE TABLE NUMBER 1
      /10X, 26HTIME VS NUMBER OF FLIGHTS
      /10X, 17HNUMBER OF FLIGHTS )
      NMT1 = NTR1(1)
      WRITE (6,70) (TABLI(I,1), I = 1, NMT1)
      FORMAT (1P10E12.4)
      NMT1P1 = NMT1 + 1
      NF = 2 * NMT1
      WRITE (6,75)
      FORMAT (/ 10X, 4HTIME)
      WRITE (6,70) (TABLI(I,1), I = NMT1P1, NF)
      K = K + 1
      IF (NMT1(2)) 90, 120
      WRITE (6,100)
      FORMAT (/10X, 21HSINGLE TABLE NUMBER 2
      /10X, 36HCRACK DENSITY FUNCTION VS CRACK SIZE
      /10X, 16HCRACK SIZE )
      NMT1 = NTR1(2)
      WRITE (6,70) (TABLI(I,2), I = 1, NMT1)
      NMT1P1 = NMT1 + 1
      NF = 2 * NMT1
      WRITE (6,110)
      FORMAT (/ 10X, 22HCRACK DENSITY FUNCTION )
      WRITE (6,70) (TABLI(I,2), I = NMT1P1, NF)
      K = K + 1
      IF (K - 2) 120, 120, 115
      NPAGE = NPAGE + 1
      CALL PAGENO
      K = - 1
      IF (NMT1(3)) 130, 180
      WRITE (6,140)
      FORMAT (/10X, 21HSINGLE TABLE NUMBER 3
      /10X, 36HINSPECTION RELIABILITY VS CRACK SIZE
      /10X, 16HCRACK SIZE )
      NMT1 = NTR1(3)
      WRITE (6,70) (TABLI(I,3), I = 1, NMT1)
      NMT1P1 = NMT1 + 1
      NF = 2 * NMT1
      WRITE (6,150)
      FORMAT (/ 10X, 22HINSPECTION RELIABILITY)
      WRITE (6,70) (TABLI(I,3), I = NMT1P1, NF)
      K = K + 1
      IF (K - 2) 170, 170, 160
      NPAGE = NPAGE + 1
      CALL PAGENO
      K = 0
      IF (NMT1(4)) 180, 220
      WRITE (6,190)

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1      SUBROUTINE PCBN
      SUBROUTINE FOR CALCULATING THE MODIFIED PCB TABLE
      COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)
      DIMENSION NTB1(5), CRACKL(100), PCBT(100)
      EQUIVALENCE N(61), NTB1
      NCRL = 2 * NTB1(2) - 2
      CRACKL(1) = TABL1(1,2)
      NC = NTB1(2)
      PCBT(1) = TABL1(NC+1,2)
      NCN1 = NC - 1
      DO 10 J = 2, NCN1
      CRACKL(2*J-2) = TABL1(J,2)
      CRACKL(2*J-1) = TABL1(J,2) * 1.000001
      PCBT(2*J-2) = TABL1(NC+J,2)
      PCBT(2*J-1) = TABL1(NC+J,2)
      CRACKL(2*NC-2) = TABL1(NC,2)
      PCBT(2*NC-2) = TABL1(2*NC,2)
      NTB1(5) = 2 * NC - 2
      NCRL = NTB1(5)
      DO 20 J = 1, NCRL
      TABL1(J,5) = CRACKL(J)
      TABL1(NCRL+J,5) = PCBT(J)
      RETURN
      END
20

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PCBN 22
PCBN 23

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
1 PCBN

VARIABLES	SN	TYPE	RELOCATION	ARRAY	INTEGER	REAL
50 CRACKL		REAL		ARRAY		
21-58 N		INTEGER	//	ARRAY		
46 NCN1		INTEGER			47 J	INTEGER
21544 NTB1		INTEGER	//		45 NC	INTEGER
214 PCBT		REAL		ARRAY	44 NCRL	INTEGER
26354 TABL2		REAL	//	ARRAY	5 P	REAL
					24484 TABL1	REAL

STATEMENT LABELS

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
17	18	J	11 15	58	INSTACK
36	28	J	28 22	48	INSTACK

COMMON BLOCKS
// LENGTH
13500

STATISTICS
NONZERO LENGTH

ZERO 244

```

1      SUBROUTINE CALC
2      SUBROUTINE FOR CALCULATING THE TIME DEPENDENT FAILURE
3      PROBABILITY FOR A CONTROL POINT
4      COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)
5      DIMENSION PSIL(50), PFST(400), TIM2L(400),
6      TIME(400), PCBT(100), CRACKL(100), TIME(400),
7      DIMENSION MTB1(5), MTB2(3), MTB22(3)
8      DIMENSION NFLT(400), MISS(400), NIN(20), NRE(20),
9      EQUIVALENCE (P(1), DELCR), P(2), DELST
10     EQUIVALENCE (P(50), RMIS),
11     EQUIVALENCE (P(51), PFBCI), P(52), DLAREA)
12     EQUIVALENCE (P(101), PSIL), P(151), PFBCI),
13     EQUIVALENCE (P(951), TIMI), P(971), TI43),
14     EQUIVALENCE (P(1091), CRACKL), P(1131), TIME)
15     EQUIVALENCE (P(16791), DAREAP)
16     EQUIVALENCE (N(15), NP), N(16), NT45),
17     EQUIVALENCE (N(18), NREKO), N(22), N2QNT)
18     EQUIVALENCE (N(43), JN4SP), N(44), JREKO),
19     EQUIVALENCE (N(57), MPSIL), N(58), MDLSL)
20     EQUIVALENCE (N(61), NTS1), N(69), NTB12),
21     EQUIVALENCE (N(101), NFLT), N(501), MISS),
22     EQUIVALENCE (N(921), NRE), N(951), NUMF)
23     DLAREA = DELCR * DELST
24     KT = 1
25     NCLC = 1
26     MPSIL = MTB12(1)
27     NCRL = MTB1(5)
28     COMPUTE THE DAREAP ELEMENTS
29     DO 2 J = 1, NCPL
30     CRACKL(J) = TABL1(J,5)
31     PCBT(J) = TABL1(NCRL+J,5)
32     DO 4 J = 2, NCRL
33     DAREAP(J-1) = 8.5 * (PCBT(J) + PCBT(J-1))
34     * (CRACKL(J) - CRACKL(J-1))
35     FIND THE STRESS ABSISSAS IN THE STRESS PROB DEN FUNCTION TABL
36     DO 10 I = 1, MPSIL
37     PSIL(I) = TABL2(I,1)
38     COMPUTE THE TIMES FOR FAILURE PROBABILITY CALCULATION
39     DO 20 I = 1, NTPS
40     RMFLTS = NFLT(I)
41     CALL TABS(TABL1(1,1), RMFLTS, TIM2L(1), MTB1(1))
42     I = 1
43     CHECK ON AREA UNDER THE CRACK DENSITY FUNCTION
44     DO 30 J = 1, NCRL
45     CRACKL(J) = TABL1(J,5)
46     PCBT(J) = TABL1(NCRL+J,5)
47     CALL AREAC (CRACKL, PCBT, NCRL, AREA)
48     WRITE (6,50) I, AREA
49     FORMAT (10X, 3E10, CRACK DENSITY AREA CALC. - TIME STEP =, I5,
50     4X, 6HAREA =, F8.4)
51     CORRECT THE CRACK DENSITY FUNCTION FOR AREA ERROR
52     DO 70 J = 1, NCRL
53     PCBT(J) = PCBT(J) / AREA
54     TABL1(NCRL+J,5) = PCBT(J)
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CALC 1
 CALC 2
 CALC 3
 CALC 4
 CALC 41
 CALC 5
 CALC 51
 CALC 52
 CALC 53
 CALC 6
 CALC 61
 CALC 62
 CALC 7
 CALC 8
 CALC 9
 CALC 10
 CALC 101
 CALC 11
 CALC 12
 CALC 121
 CALC 122
 CALC 123
 CALC 124
 CALC 125
 CALC 126
 CALC 127
 CALC 13
 CALC 14
 CALC 15
 CALC 16
 CALC 16
 CALC 17
 CALC 171
 CALC 172
 CALC 173
 CALC 174
 CALC 175
 CALC 18
 CALC 19
 CALC 20
 CALC 21
 CALC 22
 CALC 23
 CALC 24
 CALC 25
 CALC 26
 CALC 27
 CALC 28
 CALC 29
 CALC 30
 CALC 32
 CALC 33
 CALC 34
 CALC 36
 CALC 37
 CALC 38
 CALC 381

```

64      C      CHECK ON MISSION BEING FLOWN
          RMIS = MISS(I)
          CALL PCALC
          PFBC(T) = PFBC
          TIME(T) = TIME(T)
          NUMF(T) = NFLT(I)
          CHECK FOR END OF RUN
          IF (I - NTNS) 110, 230, 238
          NFLT1 = NFLT(I+1)
          CALL TABS(TAB1(I), RFLT1, TIME(T+1), NTB1(I))
          CHECK FOR INSPECTION BEFORE NEXT TIME STEP
          IF (NINSF) 120, 160
          DO 130 J = 1, NINSF
          IF (NIN(J) - NFLT(I)) 130, 140
          CONTINUE
          GO TO 160
          JINSP = J
          RMIN = MIN(JINSP)
          CALL TABS(TAB1(I), RMIN, TIME(JINSP), NTB1(I))
          CALL INSPEC
          CALL PCALC
          KT = KT + 1
          PFBC(T) = PFBC
          TIME(T) = TIME(JINSP)
          NUMF(T) = NFLT(I)
          CHECK FOR RENOPK BEFORE NEXT TIME STEP
          IF (NREWK) 170, 210
          DO 180 J = 1, NREWK
          IF (NRE(J) - NFLT(I)) 180, 190
          CONTINUE
          GO TO 210
          JREWK = J
          NRE = NRE(JREWK)
          CALL TABS(TAB1(I), NRE, TIME(JREWK), NTB1(I))
          CALL RENOPK
          CALL PCALC
          KT = KT + 1
          PFBC(T) = PFBC
          TIME(T) = TIME(JREWK)
          NUMF(T) = NFLT(I)
          DELTIM = TIME(T+1) - TIME(T)
          MCRL = NTB1(I)
          DO 221 J = 1, MCRL
          IF (CRACKL(J)) 212, 220
          CALL TABS(TAB2(I), CRACKL(J), RMIS, TB,
          1  NTB12(2), NTB22(2))
          TIM = TB + DELTIM
          CALL TABS(TAB2(I), TIM, RMIS, CRACKL(J),
          1  NTB12(2), NTB22(2))
          TAB1(J,5) = CRACKL(J)
          CONTINUE
          IF (NPRINT) 223, 225
          WRITE (6,224) (CRACKL(I), I = 1, MCRL)
          DO 226 J = 2, MCRL, 2
          DUMJ = PCBT(J)
          DUMJN1 = PCBT(J-1)
          FORMAT (1P10E12.4)
          212 1  NTB12(2), NTB22(2)
          218 1  NTB12(2), NTB22(2)
          220 221
          221 221
          223 224
          224 225
          225 225

```

```

115      IF (DUMJ1 2251, 2252
      PCB1(J) = DAREAP(J-1) * DUMJ /
      1      (0.5 * (DUMJ1 + DUMJ11) * (CRACKL(J) - CRACKL(J-1)))
2252      IF (DUMJ11) 2253, 226
2253      PCB1(J-1) = DAREAP(J-1) * DUMJ1 /
      1      (0.5 * (DUMJ + DUMJ11) * (CRACKL(J) - CRACKL(J-1)))
128      CONTINUE
      DO 228 J = 1, MCRL
      TABL1(MCRL+J,5) = PCB1(J)
228      KT = KT + 1
      1 = 1 + 1
125      IF (I - NTNS) 22, 22, 248
      CALL FINCLC
      RETURN
      END
248
250

```

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS	1	CALC
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	16	16
17	17	17
18	18	18
19	19	19
20	20	20
21	21	21
22	22	22
23	23	23
24	24	24
25	25	25
26	26	26
27	27	27
28	28	28
29	29	29
30	30	30
31	31	31
32	32	32
33	33	33
34	34	34
35	35	35
36	36	36
37	37	37
38	38	38
39	39	39
40	40	40
41	41	41
42	42	42
43	43	43
44	44	44
45	45	45
46	46	46
47	47	47
48	48	48
49	49	49
50	50	50
51	51	51
52	52	52
53	53	53
54	54	54
55	55	55
56	56	56
57	57	57
58	58	58
59	59	59
60	60	60
61	61	61
62	62	62
63	63	63
64	64	64
65	65	65
66	66	66
67	67	67
68	68	68
69	69	69
70	70	70
71	71	71
72	72	72
73	73	73
74	74	74
75	75	75
76	76	76
77	77	77
78	78	78
79	79	79
80	80	80
81	81	81
82	82	82
83	83	83
84	84	84
85	85	85
86	86	86
87	87	87
88	88	88
89	89	89
90	90	90
91	91	91
92	92	92
93	93	93
94	94	94
95	95	95
96	96	96
97	97	97
98	98	98
99	99	99
100	100	100

VARIABLES	SM	TYPE	RELOCATION
364 AREA	REAL		
21126 DAREAP	REAL	ARRAY	
1 DELST	REAL		
63 DLAREA	REAL		
375 DUHJMI	REAL		
361 J	INTEGER		
21523 JRENK	INTEGER		
373 M	INTEGER		
21450 N	INTEGER	ARRAY	
21531 MDCLC	INTEGER		
23254 MIN	INTEGER	ARRAY	
21456 MP	INTEGER		
21526 MPSIL	INTEGER		
21471 MRNK	INTEGER		
21554 MTB12	INTEGER	ARRAY	
21467 MTHS	INTEGER		
P	REAL	ARRAY	
62 PFCB	REAL		
144 PSIL	REAL	ARRAY	
363 RFLSTS	REAL		
366 RMN	REAL		
26494 TABL1	REAL		
371 TB	REAL	ARRAY	
1846 TINCIC	REAL	ARRAY	
1646 TIMI	REAL	ARRAY	

FILE NAMES : MCDE
TAPES : FMT

```

1      SUBROUTINE PCALC
2      SUBROUTINE FOR CALCULATING THE SINGLE FLIGHT FAILURE
3      PROBABILITY
4
5      COMMON P(9800), M(1500), TAB1(200,5), TAB2(1000,2)
6      DIMENSION PSTL(50), PPSI(50)
7      DIMENSION MTB1(50), MTB2(100), MTB22(100)
8      EQUIVALENCE (P(1), DELCRK), (P(2), DELST)
9      EQUIVALENCE (P(50), RMISS)
10     EQUIVALENCE (P(51), PFBC), (P(52), DLAREA)
11     EQUIVALENCE (P(101), PSIL)
12     EQUIVALENCE (M(10), RMISS), (M(20), MLEN),
13     (M(21), NJST)
14     EQUIVALENCE (M(61), MTB1), (M(62), MTB12),
15     (M(72), MTB22)
16     EQUIVALENCE (M(47), MPSIL),
17     (M(50), MDCLC)
18     FIND THE STRESS DENSITY FUNCTION
19     IF (MDCLC) 5, 105
20     RMISS = MTB22(1)
21     DO 101 I = 1, RMISS
22     DO 20 I = 1, MPSIL
23     MI = MTB12(1) + MTB22(1) + (RMISS - 1) * MTB12(1)
24     I = I + 1
25     CHECK AREA UNDER THE DENSITY FUNCTION
26     MC = MTB12(1) + MTB22(1) + (RMISS - 1) * MTB12(1)
27     CALL AREAS(PSTL, PPSI, MPSIL, AREA)
28     WRITE (6,94) AREA
29     FORMAT (10X, 30STRESS DENSITY FUNCTION CALC. - AREA =, F8.4)
30     DO 95 I = 1, MPSIL
31     PPSI(I) = PPSI(I) / AREA
32     PLACE THE STRESS DENSITY FUNCTION IN A TABLE
33     MTB121 = MTB12(1)
34     DO 100 I = 1, MPSIL
35     TAB12(MC+I,1) = PPSI(I)
36     CONTINUE
37     MDCLC = 0
38     COMPUTE THE SINGLE FLIGHT FAILURE PROBABILITY
39     PFBC = 0.0
40     DO 120 I = 1, MLEN
41     DO 120 JST = 1, NJST
42     RLEN = LEN
43     RJST = JST
44     CRKLEN = (RLEN - 0.5) * DELCRK
45     STRESS = (RJST - 0.5) * DELST
46     CALL TABS(TAB1(1,4), CRKLEN, SCB, MTB1(4))
47     IF (STRESS - SCB) 120, 112, 110
48     CALL TABS(TAB2(1,1), STRESS, RMISS, PDSBC,
49     MTB22(1))
50     IF (PDSBC) 115, 120
51     CALL TABS (TAB1(1,5), CRKLEN, PCB, MTB1(5))
52     PFBC = PCB + PDSBC + DLAREA + PFBC
53     CONTINUE
54     RETURN
55     END

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1      C      SUBROUTINE TO MODIFY THE CRACK DISTRIBUTION AFTER INSPECTION
2      COMMON P(9800), N(1500), TABL1(200,5), TABL2(1000,2)
3      DIMENSION PCBT(100), CRACKL(100), DUM(100),
4      INSP 1
5      DUM(100), DAREP(100)
6      DIMENSION MTB1(5)
7      EQUIVALENCE (P(4), AI)
8      EQUIVALENCE (P(991), PCBT), (P(1091), CRACKL),
9      INSP 2
10      DAREP(100)
11      EQUIVALENCE (N(43), JN4SP)
12      EQUIVALENCE (N(61), MTB1)
13      NCRL = MTB1(5)
14      DO 10 I = 1, NCRL
15      CALL TABS(TABL1(I,3), CRACKL(I), PL, MTB1(3))
16      PCBT(I) = PI * PCBT(I)
17      CALL AREAC(CRACKL, PCBT, MTB1(5), AREAL)
18      DO 30 I = 1, NCRL
19      IF (CRACKL(I) - AI) 20, 40, 40
20      PCBT(I) = PCBT(I) + (1.0 - AREAL) / AI
21      CONTINUE
22      ICNT = I
23      DO 50 J = ICNT, NCRL
24      DUM(J) = PCBT(J)
25      DUM(J) = CRACKL(J)
26      DO 60 J = ICNT, NCRL
27      PCBT(J+2) = DUM(J)
28      CRACKL(J+2) = DUM(J)
29      CALL TABS(TABL1(I,3), AI, PI, MTB1(3))
30      CALL TABS(TABL1(I,5), AI, PCB, MTB1(5))
31      CALL TABS(TABL1(I,5), AI, PCB, MTB1(2))
32      PCBT(ICNT) = PI * PCB + (1.0 - AREAL) / AI
33      PCBT(ICNT+1) = PI * PCB
34      CRACKL(ICNT) = AI
35      CRACKL(ICNT+1) = AI * 1.000201
36      IF (CRACKL(ICNT+1) - CRACKL(ICNT+2)) 96, 70, 70
37      WRITE (6,88)
38      FORMAT (18X, 27HCRACK LENGTH ERROR - INSPEC)
39      CALL GUIDE
40      MTB1(5) = MTB1(5) + 2
41      CALL AREAC(CRACKL, PCBT, MTB1(5), AREAL)
42      WRITE (6,100) MTB1(5), AREAL
43      FORMAT (18X, 39HCRACK DENSITY AREA CALC. - NO. OF PTS =, 15,
44      4X, 6HAREA =, F8.5, 2X, 6HINSPEC)
45      NCRL = MTB1(5)
46      DO 115 J = 1, NCRL
47      TABL1(J,5) = CRACKL(J)
48      PCBT(J) = PCBT(J) / AREAL
49      TABL1(MCRL+J,5) = PCBT(J)
50      DO 116 J = 2, NCRL
51      DAREP(J-1) = 0.5 * (PCBT(J) + PCBT(J-1))
52      * (CRACKL(J) - CRACKL(J-1))
53      RETURN
54      END
55      INSP 3
56      INSP 4
57      INSP 5
58      INSP 6
59      INSP 61
60      INSP 7
61      INSP 71
62      INSP 72
63      INSP 8
64      INSP 9
65      INSP 12
66      INSP 13
67      INSP 14
68      INSP 15
69      INSP 16
70      INSP 17
71      INSP 18
72      INSP 19
73      INSP 20
74      INSP 21
75      INSP 22
76      INSP 23
77      INSP 24
78      INSP 25
79      INSP 26
80      INSP 27
81      INSP 28
82      INSP 29
83      INSP 30
84      INSP 31
85      INSP 32
86      INSP 33
87      INSP 34
88      INSP 35
89      INSP 36
90      INSP 37
91      INSP 39
92      INSP 40
93      INSP 41
94      INSP 42
95      INSP 43
96      INSP 44
97      INSP 45
98      INSP 46
99      INSP 461
100     INSP 462
101     INSP 463
102     INSP 47
103     INSP 48

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```

1      SUBROUTINE REMORK
2      COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)
3      DIMENSION PCBT(100), CRACKL(100), DUM(100),
4      DAREAP(100)
5      DIMENSION NTB1(5)
6      EQUIVALENCE (P(5), ARE2), (P(6), ARE0)
7      EQUIVALENCE (P(991), PCBT), (P(1001), CRACKL),
8      DAREAP)
9      EQUIVALENCE (N(44), JREMK)
10     EQUIVALENCE (N(61), NTB1)
11     MCRL = NTB1(5)
12     DO 10 I = 1, MCRL
13     CRACKL(I) = TABL1(I,5)
14     PCBT(I) = TABL1(I+MCPL,5)
15     COMPUTE NUMBER OF ABSCISSAS LESS THAN ARE0
16     MCNT = 0
17     DO 30 I = 1, MCRL
18     IF (CRACKL(I) - ARE0) 20, 30, 30
19     MCNT = MCNT + 1
20     CONTINUE
21     DETERMINE IF MCNT IS ODD OR EVEN
22     MTEST = 1
23     DO 40 I = 1, MCNT
24     MTEST = - MTEST
25     REDORDER THE CRACK DISTRIBUTION FUNCTION
26     IF (MTEST) 50, 150, 80
27     MCNTM1 = MCNT - 1
28     MCRLT = MCRL - MCNTM1
29     DO 60 I = 2, MCRLT
30     DUM(I) = PCBT(I+MCNTM1)
31     DUM(I) = CRACKL(I+MCNTM1)
32     DO 70 I = 2, MCRLT
33     PCBT(I) = DUM(I)
34     CRACKL(I) = DUM(I) - ARE2
35     NTB1(5) = MCRLT
36     CRACKL(1) = 0.0
37     GO TO 110
38     MCNTM2 = MCNT - 2
39     MCRLT = MCRL - MCNTM2
40     DO 90 I = 3, MCRLT
41     DUM(I) = PCBT(I+MCNTM2)
42     DUM(I) = CRACKL(I+MCNTM2)
43     DO 100 I = 3, MCRLT
44     PCBT(I) = DUM(I)
45     CRACKL(I) = DUM(I) - ARE2
46     NTB1(5) = MCRLT
47     CRACKL(1) = 0.0
48     CRACKL(2) = CRACKL(3) - 0.0000001
49     PCBT(1) = 0.0
50     PCBT(2) = 0.0
51     CALL AREAC(CRACKL, PCBT, NTB1(5), AREA1)
52     PCBT(1) = (1.0 - AREA1) / CRACKL(2)
53     PCBT(2) = PCBT(1)
54     CALL AREA(CRACKL, PCBT, NTB1(5), AREAR)
55     WRITE (6,120) NTB1(5), AREAR, A-1C

```

REMK 1
 REMK 2
 REMK 3
 REMK 4
 REMK 41
 REMK 5
 REMK 6
 REMK 61
 REMK 7
 REMK 71
 REMK 72
 REMK 8
 REMK 9
 REMK 10
 REMK 11
 REMK 12
 REMK 13
 REMK 14
 REMK 15
 REMK 16
 REMK 17
 REMK 18
 REMK 19
 REMK 20
 REMK 21
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 REMK 32
 REMK 33
 REMK 34
 REMK 35
 REMK 36
 REMK 37
 REMK 38
 REMK 39
 REMK 40
 REMK 41
 REMK 42
 REMK 43
 REMK 44
 REMK 45
 REMK 46
 REMK 47
 REMK 48
 REMK 49
 REMK 50
 REMK 51
 REMK 52
 REMK 53

```

120 1      FORMAT (10X, 39HCRACK DENSITY AREA CALC. - NO. OF PTS =, 15,
      64      4X, 6HAREA =, F9.5, 2X, 7HREWORK(2)
      DO 130 I = 1, NCRLT
      PCBT(I) = PCBT(I) / AREAR
      TABL1(I,F) = CRACKL(I)
      TABL1(I+NCRLT,5) = PCBT(I)
      DO 140 J = 2, NCRLT
      DAREP(J-1) = 8.5 * (PCBT(J) + PCBT(J-1))
      65      1 * (CRACKL(J) - CRACKL(J-1))
      150      RETURN
      END
  
```

REMK 54
REMK 55
REMK 56
REMK 57
REMK 58
REMK 59
REMK 60
REMK 61
REMK 62
REMK 63
REMK 64

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
1 REMORK

VARIABLES	SN	TYPE	RELOCATION
221 AREAR	REAL	REAL	228 AREAR
4 ARR	REAL	REAL	5 ARR
2182 CRACKL	REAL	REAL	21126 DAREP
223 DUM	REAL	REAL	367 DUM
212 I	INTEGER	INTEGER	222 J
21523 JREK	INTEGER	INTEGER	214 MTEST
21458 M	INTEGER	INTEGER	213 NCNT
215 MONTH1	INTEGER	INTEGER	217 NCNT2
211 NCRL	INTEGER	INTEGER	216 NCRLT
21544 NTB1	INTEGER	INTEGER	P
1736 PCBT	REAL	REAL	24484 TABL1
26354 TABL2	REAL	REAL	

FILE NAMES
TAPE6
FMT

EXTERNALS
AREAR
TYPE
AREAR

STATEMENT LABELS

STATEMENT LABELS	INEX	FROM-TO	LENGTH	PROPERTIES
18 18	I	13 15	48	INSTACK
21 38	I	18 21	58	INSTACK
32 48	I	24 25	28	INSTACK
47 68	I	30 32	48	INSTACK
56 78	I	33 35	58	INSTACK
76 98	I	41 43	48	INSTACK
105 108	I	44 46	58	INSTACK
136 138	I	68 63	48	INSTACK

LOOPS LABEL

LOOPS LABEL	INEX	FROM-TO	LENGTH	PROPERTIES
25 38	I	13 15	48	INSTACK
68 68	I	18 21	58	INSTACK
98 98	I	24 25	28	INSTACK
128 128	I	30 32	48	INSTACK
158 158	I	33 35	58	INSTACK
175 175	I	41 43	48	INSTACK
195 195	I	44 46	58	INSTACK
215 215	I	68 63	48	INSTACK

FMT

```

1      SUBROUTINE FINGLC
      SUBROUTINE FOR COMPUTING THE EXPECTED NUMBER OF FAILURES
      IN A FLEET
      COMMON P(9888), N(1588), TABL1(288,5), TABL2(1888,2)
      DIMENSION PF8CT(488), TIME(488), PF8T(488,15),
      PF(488), PFF(488)
      DIMENSION MTB(15), NFLT5(488), NPM(15)
      EQUIVALENCE (P(151), PF8CT), (P(191), TIME),
      (P(1591), PF8T), (P(7591), PFT), (P(7991), PFI), (P(8391), PFF)
      EQUIVALENCE (N(13), NA), (N(14), NCONTP),
      (N(15), NP), (N(16), NTHS)
      EQUIVALENCE (N(61), NTH1)
      EQUIVALENCE (N(45), KT)
      EQUIVALENCE (N(75), NPM)
      EQUIVALENCE (N(81), NFLT5)
      PRODT = 1.0
      DO 10 I = 1, KT
      PF8T(I, NCONTP) = PF8CT(I)
      IF (NCONTP - NP) 120, 20, 20
      COMPUTE THE SINGLE FLIGHT PROBABILITY OF FAILURE FOR THE
      AIRCRAFT
      DO 40 J = 1, KT
      PRODT = 1.0
      DO 30 J = 1, NP
      NPMJ = NPM(J)
      DO 30 K = 1, NPMJ
      PRODT = (1.0 - PFT(I, J)) * PRODT
      PFT(I) = 1.0 - PRODT
      COMPUTE THE PROBABILITY OF FAILURE FOR THE AIRCRAFT
      NF1 = 0
      NT = 1
      TIM = TIME(I)
      DO 75 I = 2, KT
      OLTIM = TIME(I) - TIM
      TIM = TIME(I)
      IF (OLTIM) 50, 45
      PFI(I) = PFI(I-1)
      GO TO 75
      NT = NT + 1
      NF = NFLT5(NT) - NF1
      NF1 = NFLT5(NT)
      RMF = NF
      DO 60 J = 1, NF
      RJ = J
      PRODT = (1.0 - (PFI(I) - PFI(I-1)) * RJ /
      RMF + PFI(I-1)) * PRODT
      PFI(I) = 1.0 - PRODT
      CONTINUE
      COMPUTE THE EXPECTED NUMBER OF FAILURES IN THE FLEET
      RNA = NA
      DO 110 I = 2, KT
      PFI(I) = RNA + PFI(I)
      RETURN
      END

```

FCLC 1
FCLC 2
FCLC 3
FCLC 4
FCLC 5
FCLC 6
FCLC 61
FCLC 7
FCLC 8
FCLC 9
FCLC 10
FCLC 101
FCLC 102
FCLC 11
FCLC 111
FCLC 112
FCLC 12
FCLC 13
FCLC 14
FCLC 15
FCLC 16
FCLC 17
FCLC 18
FCLC 19
FCLC 191
FCLC 192
FCLC 20
FCLC 21
FCLC 22
FCLC 221
FCLC 222
FCLC 223
FCLC 23
FCLC 24
FCLC 25
FCLC 26
FCLC 261
FCLC 262
FCLC 27
FCLC 28
FCLC 281
FCLC 29
FCLC 31
FCLC 311
FCLC 32
FCLC 33
FCLC 34
FCLC 35
FCLC 37
FCLC 38
FCLC 39
FCLC 40
FCLC 41
FCLC 42

09/17/79 18.34.26

FTN 4.7+476

SUBROUTINE AREAC 74/74 OPT=1

```

1      SUBROUTINE AREAC (X, Y, NPTS, AREA)
      C
      C SUBROUTINE TO COMPUTE THE AREA UNDER A SIMPLE GRAPH BASED ON
      C THE TRAPEZOIDAL RULE
      C NPTS = NUMBER OF X,Y PAIRS
      C
      C DIMENSION X(100), Y(100)
      C AREA = 0.0
      C NPTSM1 = NPTS - 1
      C DO 10 I = 1, NPTSM1
      C   AREA = 0.5 * (Y(I+1) + Y(I)) * (X(I+1) - X(I))
      C 10 + AREA
      C RETURN
      C END
      C
      C AREA 1
      C AREA 2
      C AREA 3
      C AREA 4
      C AREA 5
      C AREA 6
      C AREA 7
      C AREA 8
      C AREA 9
      C AREA 10
      C AREA 11
      C AREA 12

```

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
3 AREAC

VARIABLES	SN	TYPE	RELOCATION
AREA	0	REAL	F.P.
NPTS	0	INTEGER	F.P.
X	0	REAL	F.P.
		ARRAY	

STATEMENT LABELS

0 10

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
16	10	1	0 9	68	INSTACK

STATISTICS	PROGRAM LENGTH	328	26
	528000	CM USED	

27	I	INTEGER	ARRAY	F.P.
26	NPTSM1	INTEGER		
0	Y	REAL		

09/17/79 10.34.26

FTV 4.7+476

74/74 OPT=1

AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
AREA 7
AREA 8
AREA 9
AREA 10
AREA 11
AREA 12

```

1      C      SUBROUTINE AREAS (X, Y, NPTS, AREA)
          SUBROUTINE TO COMPUTE THE AREA UNDER A SIMPLE GRAPH BASED ON
          THE TRAPEZOIDAL RULE
          NPTS = NUMBER OF X,Y PAIRS
          DIMENSION X(50), Y(50)
          AREA = 0.0
          NPTSM1 = NPTS - 1
          DO 10 I = 1, NPTSM1
              AREA = 0.5 * (Y(I+1) + Y(I)) * (X(I+1) - X(I))
10      1 + AREA
          RETURN
          END

```

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
3 AREAS

VARIABLES	SM	TYPE	RELOCATION	27 I	INTERSE	F.P.
0 AREA	REAL		F.P.	26 NPTSM1	INTERSE	
0 NPTS	INTEGER		F.P.	6 Y	REAL	
0 X	REAL		F.P.		ARRAY	

STATEMENT LABELS
0 10

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
16	10	I	8 9	68	INSTACK

STATISTICS
PROGRAM LENGTH 328 26
52000 CH USED

09/17/79 18.34.24

FTN 4.7+476

OPT=1

74/74

SUBROUTINE TABS

```

1      C
      C
      SUBROUTINE TABS (TABLE, XIARG, AMP, NTAB1)
      LOOK UP
      SUBROUTINE FOR STRAIGHT LINE INTERPOLATION IN A SINGLE TABLE
      DIMENSION TABLE(200)
      DO 18 I1 = 1, NTAB1
      IF (TABLE(I1) - XIARG) 10, 20, 20
      CONTINUE
      I1 = NTAB1
      IF (I1 - 1) 30, 30, 40
      I1 = 2
      I1 = 2
      N2 = NTAB1 + I1
      N1 = N2 - 1
      XIARG = (XIARG - TABLE(I1-1)) /
      AMP = TABLE(N1) + XIARG * (TABLE(N2) - TABLE(N1))
      RETURN
      END
15

```

STAB 1
STAB 2
STAB 3
STAB 4
STAB 5
STAB 6
STAB 7
STAB 8
STAB 9
STAB 10
STAB 11
STAB 12
STAB 13
STAB 14
STAB 15
STAB 16
STAB 17

SYMBOLIC REFERENCE MAP (R-1)

ENTRY POINTS
3 TABS

VARIABLES	SN	TYPE	RELOCATION
AMP	8	REAL	F.P.
NTAB1	8	INTEGER	F.P.
N2	36	INTEGER	F.P.
XIARG	8	REAL	F.P.

35 I1	INTEGER	
37 N1 <td>INTEGER <td></td> </td>	INTEGER <td></td>	
0 <td>TABLE <td>ARRAY</td> </td>	TABLE <td>ARRAY</td>	ARRAY
40 <td>XIARG <td>REAL</td> </td>	XIARG <td>REAL</td>	REAL

F.P.

STATEMENT LABELS

8	18	16	20
21	48		

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	EXITS
7	10	11	5	7	INSTACK	

STATISTICS
PROGRAM LENGTH 458 37
528088 CM USED

INACTIVE

0 30


```

1      SUBROUTINE TABDSI(TABLE, XIARG, X2ARG, AMP,
C      SUBROUTINE FOR STRAIGHT LINE INTERPOLATION IN A DOUBLE
C      TABLE LOOK - INVERSE FUNCTION
C      DIMENSION TABLE (1000)
C      NTAB1 = NTAB1 + 1
C      NN12 = NTAB1 + NTAB2
C      DO 10 I2 = NTAB1, NN12
C      IF (TABLE(I2) - X2ARG) 18, 40, 20
C      CONTINUE
C      WRITE (6,30) I2, X2ARG, TABLE(I2)
C      FORMAT (10X, 12HTABDSI ERROR, 2X, 4H12 =, I5, 2X, 7HX2ARG =,
C      E15.7, 2X, //11HTABDSI(I2) =, E15.7)
C      DO 50 I1 = 1, NTAB1
C      N22 = NN12 + (I2 - NTAB1 - 1) * NTAB1 + I1
C      IF (TABLE(N22) - XIARG) 50, 60, 60
C      CONTINUE
C      I1 = NTAB1
C      IF (I1 - 1) 70, 70, 80
C      I1 = 2
C      N22 = NN12 + (I2 - NTAB1 - 1) * NTAB1 + 2
C      XIARG = (XIARG - TABLE(N22-1)) /
C      (TABLE(N22) - TABLE(N22-1))
C      AMP = TABLE(I1 - 1) + XIARG * (TABLE(I1) -
C      TABLE(I1-1))
C      RETURN
C      END

```

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
3 TABDSI

VARIABLES	SW	TYPE	RELOCATION	F.P.
0 AMP	REAL			
182 I2	INTEGER			
0 NTAB1	INTEGER			
100 NTAB1	INTEGER			
0 TABLE	REAL			
105 XIARG	REAL			
FILE NAMES	MODE			
TAPES	FMT			

STATEMENT LABELS

0 18	26 28
25 40	8 50
0 70	47 80

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	EXITS
12 18	0 12	0 18	6 18	68	INSTACK	EXITS
26 58	0 11	14 17	108	108	OPT	EXITS

57 38 FMT
48 68

```

1      C      SUBROUTINE PAGEHD
          SUBROUTINE PAGEHD
          COMMON P(9800), N(1500), TABL1(200,5), TABL2(1000,2)
          INTEGER DAY, YEAR
          EQUIVALENCE (N(1), IDENT), (N(8), MONTH),
          (N(9), DAY), (N(10), YEAR), (N(43), NPAGE)
          WRITE (6,10) IDENT, MONTH, DAY, YEAR, NPAGE
          FORMAT (1H1, 9X, 6HNUM MO, 16, 18X, 4HDATE, 14, 1H/, 12, 1H/,
          14, 18X, 7HPAGE NO, 16)
          RETURN
          END
10

```

PAGE 1
PAGE 2
PAGE 3
PAGE 4
PAGE 5
PAGE 6
PAGE 7
PAGE 8
PAGE 9
PAGE 10
PAGE 11

SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
1 PAGEHD

VARIABLES	SN	TYPE	RELOCATION	
21460 DAY		INTEGER	//	
21457 MONTH		INTEGER	//	
21530 NPAGE		INTEGER	//	
24484 TABL1		REAL	//	
21461 YEAR		INTEGER	//	
		ARRAY		
		IDENT		
		INTEGER		
		INTEGER		
		REAL		
		REAL		
		TABLE 2		
		26354		
		8		
		P		
		N		
		21450		
		21450		
		IDENT		
		INTEGER		
		ARRAY		
		ARRAY		
		ARRAY		

FILE NAMES
TAPE6 FMT

STATEMENT LABELS
15 10 FMT

COMMON BLOCKS
// LENGTH 13500

STATISTICS
PROGRAM LENGTH 248 28
CH BLANK COMMON LENGTH 322748 13500
320008 CH USED

```

1      SUBROUTINE PRINTR
2      COMMON P(5000), N(1500), TABL1(1200,5), TABL2(1000,2)
3      DIMENSION TIME(400), PFBT(400,15), PFT(400),
4      PFE(400), NUMF(400)
5      EQUIVALENCE (P(1191), TIME), (P(1591), PFBT),
6      PFT), (P(1791), PF), (P(2391), PFE)
7      EQUIVALENCE (N(13), NA), (N(14), NCM1P), (N(15), NP)
8      EQUIVALENCE (N(45), KT), (N(49), NPAGE)
9      EQUIVALENCE (N(961), NUMF)
10     NPAGE = NPAGE + 1
11     CALL PAGEHD
12     RKT = KT
13     CNT = (RKT / 55.8) + 8.99999
14     NCNT = CNT
15     NCNT = 1
16     NFORK = 1
17     WRITE (6,20)
18     FORMAT (/10X, 42HCONTROL POINT SINGLE FLIGHT FAILURE PR38,
19     //7X, 2HNO, 7X, 4HTIME, 7X, 4HCP 1, 7X, 4HCP 2, 7X, 4HCP 3,
20     7X, 4HCP 4, 7X, 4HCP 5, 7X, 4HCP 6, 7X, 4HCP 7, 7X, 4HCP 8,
21     7X, 4HCP 9, 7X, 4HCP 10)
22     IF (NFORK - 1) 36J, 38, 78
23     IF (KT - 55 * NCNT) 98, 98, 48
24     NC1 = (NCNT - 1) * 55 + 1
25     NC2 = NCNT * 55
26     DO 50 J = NC1, NC2
27     IF (NP - 10) 42, 44, 44
28     WRITE (6,68) J, TIME(J), (PFBT(J,I), I = 1, NP)
29     GO TO 58
30     WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, 10)
31     CONTINUE
32     FORMAT (19, 1P11E11.3)
33     IF (NCNT - NCNT * 1) 62, 64, 64
34     NCNT = NCNT + 1
35     NFORK = 1
36     NPAGE = NPAGE + 1
37     CALL PAGEHD
38     GO TO 18
39     NFORK = 2
40     NPAGE = NPAGE + 1
41     CALL PAGEHD
42     GO TO 18
43     NC1 = NCNT * 55 + 1
44     DO 62 J = NC1, KT
45     IF (NP - 10) 72, 74, 74
46     WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, NP)
47     GO TO 88
48     CONTINUE
49     GO TO 110
50     DO 100 J = 1, KT
51     IF (NP - 10) 92, 94, 94
52     WRITE (6,68) J, TIME(J), (PFBT(J,I), I = 1, NP)
53     GO TO 108
54     WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, 10)
55     CONTINUE
56     PRINT 1
57     PRINT 2
58     PRINT 3
59     PRINT 4
60     PRINT 5
61     PRINT 6
62     PRINT 7
63     PRINT 8
64     PRINT 9
65     PRINT 10
66     PRINT 11
67     PRINT 12
68     PRINT 13
69     PRINT 14
70     PRINT 15
71     PRINT 16
72     PRINT 17
73     PRINT 18
74     PRINT 19
75     PRINT 20
76     PRINT 21
77     PRINT 22
78     PRINT 23
79     PRINT 24
80     PRINT 25
81     PRINT 26
82     PRINT 27
83     PRINT 28
84     PRINT 29
85     PRINT 30
86     PRINT 31
87     PRINT 32
88     PRINT 33
89     PRINT 34
90     PRINT 35
91     PRINT 36
92     PRINT 37
93     PRINT 38
94     PRINT 39
95     PRINT 40
96     PRINT 41
97     PRINT 42
98     PRINT 43
99     PRINT 44
100    PRINT 45

```

```

110 IF (NP - 10) 212, 212, 112
112 NPAGE = NPAGE + 1
60 CALL PAGEHD
    NCNT = 1
    NFORK = 1
130 WRITE (6,140)
140 FORMAT (/10X, 42HCONTROL POINT SINGLE FLIGHT FAILURE PROB.
1  //7X, 2HNO, 7X, 4HTIME, 7X, 4HCP11, 7X, 4HCP12, 7X, 4HCP13,
2  7X, 4HCP14, 7X, 4HCP15, 7X, 4HCP16, 7X, 4HCP17, 7X, 4HCP18,
3  7X, 4HCP19, 7X, 4HCP20)
    IF (NFORK - 1) 360, 158, 188
70 IF (KT - 55 * NCNT) 280, 200, 160
    NC1 = (NCNT - 1) / 55 + 1
    NC2 = NCNT / 55
    DO 178 J = NC1, NC2
162 IF (NP - 20) 162, 164, 164
    WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, NP)
    NFORK = 2
    GO TO 170
164 WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, 20)
170 CONTINUE
    IF (NCNT - NCNT + 1) 172, 174, 174
80 NCNT = NCNT + 1
    NFORK = 1
    NPAGE = NPAGE + 1
    CALL PAGEHD
    GO TO 130
85 NFORK = 2
    NPAGE = NPAGE + 1
    CALL PAGEHD
    GO TO 130
100 NC1 = NCNT / 55 + 1
    DO 130 J = NC1, KT
102 IF (NP - 20) 102, 104, 104
    WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, NP)
    GO TO 190
104 WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, 20)
190 CONTINUE
    GO TO 220
200 DO 210 J = 1, KT
202 IF (NP - 20) 202, 204, 204
    WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, NP)
    GO TO 210
204 WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, 20)
210 CONTINUE
212 IF (NCNT - NP) 360, 215, 215
105 NPAGE = NPAGE + 1
    CALL PAGEHD
    NFORK = 1
    WRITE (6,240)
220 FORMAT (/10X, 33H SINGLE FLIGHT FAILURE PROBABILITY
230 /10X, 20H AIRCRAFT FAILURE PROBABILITY
240 /10X, 23H EXPECTED FLEET FAILURES)
    WRITE (6,250)
250 FORMAT (/7X, 2HNO, 7X, 4HTIME, 2X, 7HFLIGHTS, 5X, 6HSINGLE,
1  3X, 6HAIRCRAFT, 6X, 5HFLEET)
258 IF (NFORK - 1) 360, 260, 308
    
```

PRINT 451
 PRINT 452
 PRINT 46
 PRINT 461
 PRINT 47
 PRINT 48
 PRINT 49
 PRINT 50
 PRINT 51
 PRINT 52
 PRINT 53
 PRINT 54
 PRINT 541
 PRINT 542
 PRINT 55
 PRINT 56
 PRINT 57
 PRINT 58
 PRINT 59
 PRINT 60
 PRINT 61
 PRINT 611
 PRINT 612
 PRINT 613
 PRINT 614
 PRINT 615
 PRINT 616
 PRINT 617
 PRINT 618
 PRINT 619
 PRINT 641
 PRINT 65
 PRINT 66
 PRINT 67
 PRINT 68
 PRINT 65
 PRINT 70
 PRINT 71
 PRINT 72
 PRINT 73
 PRINT 74
 PRINT 75
 PRINT 76
 PRINT 77
 PRINT 771
 PRINT 78
 PRINT 79
 PRINT 80
 PRINT 81
 PRINT 82
 PRINT 83
 PRINT 84
 PRINT 85
 PRINT 86
 PRINT 87
 PRINT 88

